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Alberta & Dept. of the Environment
Municipal Engineering Branch

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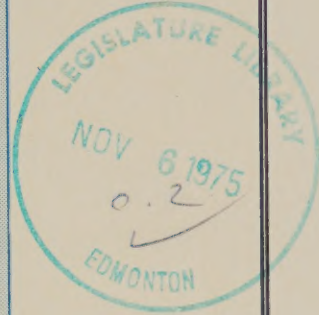
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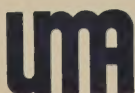
★ CROSSFIELD

★ AIRDRIE

★ CALGARY



**A Study
on
Sewage Treatment and Effluent Disposal
for Communities
in the
Calgary - Red Deer Corridor
for
Alberta Environment**



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October 24, 1974

The Government of the Province of Alberta
Department of the Environment
Municipal Engineering Branch
Milner Building, 10040 - 104 Street
EDMONTON, Alberta

Attention: Mr. M. Ellis, P. Eng.
Municipal Engineering Branch

Dear Sir:

Re: Calgary - Red Deer Corridor Sewage Study

We are pleased to transmit herewith, our engineering analysis related to sewage treatment and effluent disposal for the communities in the Calgary - Red Deer Corridor, specifically, Airdrie, Crossfield, Carstairs, Didsbury, Olds, Bowden, and Innisfail.

The cost estimates contained herein are based on anticipated 1975 costs (i.e. 1974 prices inflated by 10%) to indicate to the communities the estimated costs at the actual time of construction. For convenience, a summary of recommendations for each community has been prepared and follows this letter directly.

This study was carried out by our Mr. R. A. Baillie, M. Eng., P. Eng., and the undersigned.

Should you wish to discuss any aspects of this report, we are available at your convenience.

Yours very truly,

UNDERWOOD McLELLAN & ASSOCIATES LIMITED

A handwritten signature in dark ink, appearing to read 'Ken Brisbin'.

Per: K. J. Brisbin, M.Sc., P. Eng.
Chief Municipal Engineer

BAB/fm



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9. SUMMARY

We have evaluated preliminary engineering considerations relating present and contemplated environmental standards to existing practices and future alternatives for sewage treatment and disposal for the communities in the Calgary - Red Deer Corridor. Our conclusions and recommendations arising from this study are as follows:

9.1 General Considerations

- (i) The population in the corridor communities will approach, it is estimated, a total of approximately 50,000 by the end of the century. The proposed corridor water supply line is expected to have substantial effect on the industrial growth of Innisfail, Olds, Didsbury, and Airdrie but little effect on the abilities of Bowden, Carstairs and Crossfield to attract industry.

(ii) Existing Sewage Treatment Facilities

All communities in the corridor, with the

exception of Olds, rely on lagoons for sewage treatment. None of the lagoon systems other than Carstairs and Didsbury provide sufficient (adequate) storage for present flows and, Carstairs has the only lagoon system with excess capacity to accommodate increasing flows emanating from future populations. Olds presently has no lagoons but under new environmental standards is required to provide storage lagoons following treatment and therefore cannot be considered as providing adequate sewage treatment and disposal facilities.

- (iii) Two alternative sewage treatment and disposal schemes which were considered for all corridor communities, those of irrigation and joint treatment, are not considered viable at this time due to economic factors.

- (a) Irrigation

A detailed investigation of disposal by irrigation was beyond the scope of this report both from a time and a term

of reference framework. The amenability of wastewaters and soils in the vicinity of the corridor communities to irrigation is presently under investigation by Mr. D. N. Graveland from the Alberta Department of the Environment, Lethbridge Research Station. These investigations were not complete, other than for Airdrie, at the time of this report. Irrigation is a means of sewage disposal and therefore in all cases of alternate sewage treatment methods except one year storage lagoons, is strictly additional to the sewage treatment. That is, after the sewage has been treated by acceptable means, the effluent could then be disposed of by irrigation. In most cases this would involve additional land areas, a pumping station, irrigation distribution equipment, as well as operating personnel. The expenditures related to these factors could only be justified if the increase in return from an irrigated

acres of land would cover these costs or, if and when treatment requirements are upgraded (for example, to require tertiary treatment) such that irrigation would become a more desirable treatment alternative.

(b) Joint Treatment

The costs of a pipeline between any of the communities to enable joint treatment would be more than any savings resulting from combined treatment facilities. The communities with the best receiving areas for treated sewage are, Innisfail, Didsbury, and Airdrie. Innisfail could take the sewage from Bowden, treat it, and pipeline it along with its own treated sewage to the Red Deer River. However, it is not considered economically feasible for Bowden to pursue this alternative due to the costs of pipe-lining compared to self-treating. Didsbury presently discharges its

treated sewage to the Rosebud River. The Town of Olds and/or the Town of Carstairs could pipeline their sewage to tie in with the Didsbury sewage treatment and disposal system; however, the costs of these pipelines and the burden that would be put on the Didsbury area for treatment facilities (secondary treatment required due to limited land area for lagooning) let alone the burden on the Rosebud River to accept these volumes of sewage at one discharge location, make this alternative unattractive. Airdrie presently does not have the facilities to treat their own sewage let alone the sewage from communities such as Crossfield. It would not be economically possible for Crossfield to justify a pipeline to Airdrie to tie in with another pipeline to the Calgary sewage collection and treatment system. Therefore, the only feasible joint treatment scheme would seem to be an Airdrie to Calgary pipeline.

This would be justified by the potential expansion of Airdrie relative to other communities and the land use considerations in the Airdrie area.

9.2 Specific Recommendations for the Communities in the Calgary to Red Deer Corridor

(i) Town of Airdrie

The most technically attractive alternative for sewage treatment and disposal for Airdrie would be to construct a sewage line to Calgary. The cost of this system is estimated to be \$1.9 million, but could be reduced by employing pipeline techniques for construction of the line, and by making use of C.M.H.C. grants. Provincial assistance up to the maximum allowable could be required initially for this project depending on the cost reducing and grant possibilities.

Due to probable delay of a go-ahead for this alternative for 5 to 6 years, the recommended interim treatment scheme is an anaerobic - aerobic lagoon treatment system followed by up to 9 months storage in lagoons. The existing lagoons are to be abandoned and the recommended location for the new lagoon

system is approximately $1\frac{1}{2}$ miles south of the present site. The cost of these lagoons covering approximately 50 acres, including 80 acres of land at \$2,500 per acre is estimated to approximate \$660,000. The initial annual assistance assuming an existing debenture of \$7,328/year, an initial population of 1500, 10% interest rate, and a 25 year term, would approximate \$59,400 exclusive of any C.M.H.C. grants.

The cost of the pipeline in 1981 (reduced in length because of lagoon construction $1\frac{1}{2}$ miles closer to Calgary and northward extension of Calgary sanitary trunk sewers) is estimated to approximate \$2.3 million. The required initial annual assistance based on the above assumptions and a population of 4500, would approximate \$271,500 exclusive of C.M.H.C. grants.

(ii) Village of Crossfield

A new one year storage lagoon system located south of the railroad tracks about

¼ mile from the existing system, is the most attractive alternative for sewage treatment for Crossfield. The capital costs of this system are estimated to total \$116,540. The initial capital cost can be reduced by staging construction of the lagoon system although sufficient land area for future lagoon construction should be acquired initially. Provincial Assistance would not be applicable.

(iii) Town of Carstairs

The one year storage lagoon system would also provide the most attractive alternative for Carstairs. The capital cost of upgrading their present system to allow for population expansion and increased sewage flows to the end of the century is estimated to total \$94,140 and these costs can be spread out by staging lagoon construction. Provincial Assistance will be required if a lift station is necessary and if land areas sufficient for 20 - 25 years of lagoon construction are purchased immediately.

(iv) Town of Didsbury

The most attractive alternative for the Town of Didsbury is to continue with additional lagoon construction to meet the seven months holding requirement until further expansion in the vicinity of the existing site is no longer feasible due to land availability. At that time an aerated lagoon system could be constructed at the front end of the lagoon system with the lagoons then acting as settling and polishing lagoons before discharge to the Rosebud River. It is not anticipated the Provincial Assistance would be applicable for financial aid in upgrading the Didsbury sewage treatment and disposal system.

(v) Town of Olds

The Town of Olds is situated in a designated agricultural growth area. The existing sewage treatment plant suffers from inconsistent performance but does have the capacity to treat the sewage flows from the

Town. Due to the potential industrial growth in Olds and the resultant sewage flows however, the existing sewage treatment plant will not have the capacity to treat future flows and will therefore require either expansion or abandonment and replacement with a new system.

Our recommendation based on economics and flexibility is replacement of the existing plant by a new conventional activated sludge (or package) plant, including aerobic digestion and chlorination, followed by 4 months storage in lagoons during the winter before discharge to Olds Creek. A lift station may be required to enable the treated sewage to reach Olds Creek at the new discharge location. Due to the inconsistent past performance of the existing plant, it is further recommended that testing be carried out to determine if the sewage from Olds is indeed biologically treatable as has been assumed in this report.

Provincial Assistance initially amounting

to \$101,666, or \$110,000 if a lift station is necessary, will be required to enable Olds' debenture payments to be reduced to \$13.76/capita/year.

(vi) Village of Bowden

A one year lagoon storage system is the most economically attractive alternative for Bowden. The costs for expanding their present system to handle flows to the end of the century are estimated to amount to \$49,390. Provincial Assistance will not be applicable.

(vii) Town of Innisfail

Innisfail is presently the site of potential industrial growth, particularly a sheep processing plant. Other industry may locate in Innisfail and contribute significantly to the wastewaters to be treated. The sewage treatment system selected for Innisfail was based on the anticipated industrial growth, the quantities and qualities of the industrial wastewaters,

the financial assistance from industry,
and the availability of land for sewage
treatment.

The recommended sewage treatment and disposal
scheme for the Town of Innisfail is a
conventional activated sludge package plant,
including sludge digestion and chlorination.
A two mile pipeline to the drainage course
to the Red Deer River to allow continuous
discharge except for the four winter months
when the treated sewage could be held in
the existing lagoon system is also recommended.

Provincial Assistance initially amounting
to \$41,150 will be required by Innisfail
to reduce their debenture payments to
\$13.76/capita/year.

A STUDY
ON
SEWAGE TREATMENT AND EFFLUENT DISPOSAL
FOR
COMMUNITIES
IN THE
CALGARY - RED DEER CORRIDOR
FOR
ALBERTA ENVIRONMENT

Prepared by:

UNDERWOOD McLELLAN & ASSOCIATES LIMITED
Consulting Professional Engineers

October, 1974

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LIST OF ABBREVIATIONS

ac.ft.	acre foot
BOD	biochemical oxygen demand (5-day)
°C	degrees Centigrade
°F	degrees Fahrenheit
cfs	cubic feet per second
D.O.....	dissolved oxygen
F.M.....	food to micro-organism ratio
gpd	gallons per day
gpm	gallons per minute (Imperial unless otherwise noted)
MGD	million gallons per day
mg/l	milligrams per litre
MLSS	mixed liquor suspended solids
MLVSS	mixed liquor volatile suspended solids
ppm	parts per million

GLOSSARY OF TERMS

Adsorption - the taking up of one substance upon the surface of or interface zone of another substance.

Advanced waste treatment - renovation of used water by biological, chemical or physical methods that are applied to upgrade water quality for specific re-use requirements. May include more efficient cleanup of a general nature or the removal of components that are inefficiently removed by conventional treatment processes.

Aeration - the operation of adding oxygen to, removing volatile constituents from, or mixing a liquid by intimate contact with air.

Aerobic bacteria - organisms that require dissolved oxygen in the aquatic environment to enable them to metabolize or to grow.

Algae - primitive plants, one or many celled, usually aquatic and capable of growth on mineral materials via energy from the sun and the green colouring material, chlorophyll. Generally considered as the primary

source of food for all other organisms.

Anaerobic - a condition in which dissolved oxygen is not detectable in the aquatic environment. Commonly characterized by the formation of reduced sulphur compounds from the use of bound oxygen from sulphates as an hydrogen acceptor.

Anaerobic bacteria - Organisms that can metabolize and grow in the absence of dissolved oxygen. Their oxygen supply is obtained from the bound oxygen such as in sulphates, carbonates, or other oxygen-containing compounds.

Bacteria - primitive organisms having some of the features of plants and animals. Generally included among the fungi. Usually do not contain chlorophyll, hence commonly require preformed organic nutrients among their foods. May exist as single cells, groups, filaments, or colonies.

Biochemical oxygen demand - a measure of the oxygen utilized by micro-organisms during organic conversion and stabilization of a waste over a period of five days at the standard temperature of 20°C.

Biological processes - activities of living organisms to sustain life, growth, and reproduction. Commonly the processes by which organisms degrade complex organic material into simpler substances at a higher oxidation state to obtain energy for life processes and growth of new cell mass.

Chlorination - the process of introducing an amount of chlorine into the effluent from the sewage treatment plant for disinfection before discharge of the effluent to the water course.

Chlorophyll - the green colouring material or pigments in plants that promotes the photosynthetic reactions forming organic materials from inorganic nutrients and light energy within the living cells.

Clarification - the process of removing solids from the influent and/or from the discharge from the aeration portion of the sewage treatment plant by settling.

COD - a test for the estimation of the contamination of a wastewater in terms of oxygen requirements from a strong chemical oxidant under specific conditions, i.e., Dichromate, 50% sulphuric acid and 145°C for 2 hours.

Coliform group - a group of bacteria that inhabits the intestinal tract of warm-blooded animals, and may be found in plants, soil, air, and the aquatic environment. Includes aerobic and facultative gram negative non-spore forming bacilli that ferment lactose with gas formation.

Denitrification -

- a) the conversion of oxidized nitrogen (nitrate and nitrite-N) to nitrogen gas by contact with septic wastewater solids or other reducing chemicals.
- b) a reduction process with respect to oxidized nitrogen.

Disinfection - the destruction of pathogenic micro-organisms by chemical agents such as chlorine.

Dissolved oxygen - (D.O.) - dissolved molecular oxygen expressed in mg DO/l or percent of saturation.

Effluent - the liquid discharged from a waste treatment system after having passed through the various process stages.

Eutrophication - an action involving the aging of lakes characterized by nutrient enrichment and

increasing growth of plant and animal organisms. The net effect is to decrease depth until the lake becomes a bog and eventually dry land. Man-made pollution tends to hasten the process.

Facultative bacteria - bacteria that can adapt themselves to growth and metabolism under aerobic or anaerobic conditions. Many organisms of interest in wastewater stabilization are among this group.

Influent - the liquid entering a waste treatment system.

Inorganic - being composed of material other than plant or animal materials. Forming or belonging to the inanimate world.

Most probable number - (MPN) - a statistical method of determining microbial populations. A multiple dilution tube technique is utilized with a standard medium and observations are made for specific individual tube effects. Resultant coding is translated by mathematical probability tables into population numbers.

Nitrification - the conversion of unoxidized nitrogen (ammonia and organic N) to oxidized nitrogen (usually nitrate).

Nutrients -

- a) anything essential to support life.
- b) includes many common elements and combinations of them. The major nutrients include carbon, hydrogen, oxygen, nitrogen, sulphur, and phosphorus.
- c) nitrogen and phosphorous are of major concern because they tend to recycle and are difficult to control.

Part per million - a unit concentration and is commonly expressed as milligram per litre and is equivalent to one pound per hundred thousand gallons of water.

Pathogenic Organisms - bacterial, fungal, viral, or other organisms directly involved with diseases of plants, animals, or man, are included among this group.

pH - an index of hydrogen ion activity. Defined as the negative logarithm (base 10) of H^+ ion concentration at a given instant. On a scale of 0 to 14, pH 7.0 is neutral; pH less than 7.0 indicates a predominance of H^+ or acid ions; pH greater than 7.0 indicates a predominance of OH^- or alkaline ions.

Primary Treatment - consists of settling (sedimentation) of wastewaters with a detention period of one to two hours to effect removal of readily settleable matter. Normal efficiency range for municipal wastewaters is 35 to 65 percent (25 - 45 percent on BOD_5).

Secondary treatment - processes used to convert dissolved and colloidal materials in wastewater to a form that may be separated from the water. Commonly consists of biodegradation and conversion to cell mass in a separable form with partial oxidation, such as in activated sludge, extended aeration, or oxidation ponds. Overall efficiency of plants employing secondary treatment is in the range of 85 to 95 percent.

Settleable solids -

- a) includes materials that will settle by gravity under low flow velocities.
- b) commonly expressed in terms of the volume of solids accumulating in an Imhoff cone after one hour on a volume basis.

Standard methods - methods of analysis prescribed by joint action of APHA, ASCE, AWWA, and FWPCA. Methods accepted by authority.

Suspended solids - the concentration of insoluble materials suspended or dispersed in waste or used water. Generally expressed in mg/litre on a dry weight basis. Usually determined by filtration methods.

- those solids which are filtrable (from a sample of water) on 0.45 micron filter paper expressed on a dry weight basis per unit volume.

Total dissolved solids - the weight (per unit volume) of residue left from a sample of water after evaporation at 105°C.

Total organic carbon - a test expressing wastewater contaminant concentration in terms of the organic carbon content.

Velocity (flow) - a rate term expressed in terms of linear movement per unit of time. Commonly expressed in ft. per sec. (English) or cm/sec (metric).

Volatile material -

- a) refers to those chemicals having a vapour pressure low enough to evaporate from water readily at normal temperatures.
- b) with reference to dry solids, the term includes loss in weight upon ignition at 550^oC.

Volatile solids - those solids which are lost from the total dissolved solids or suspended solids upon ignition at 550^oC for a time period of one hour.

Wastewater - refers to the used water of a community.

Generally contaminated by the waste products from household, commercial or industrial activities. Often contains surface wash, storm water and infiltration water.

1. TERMS OF REFERENCE AND INTRODUCTION

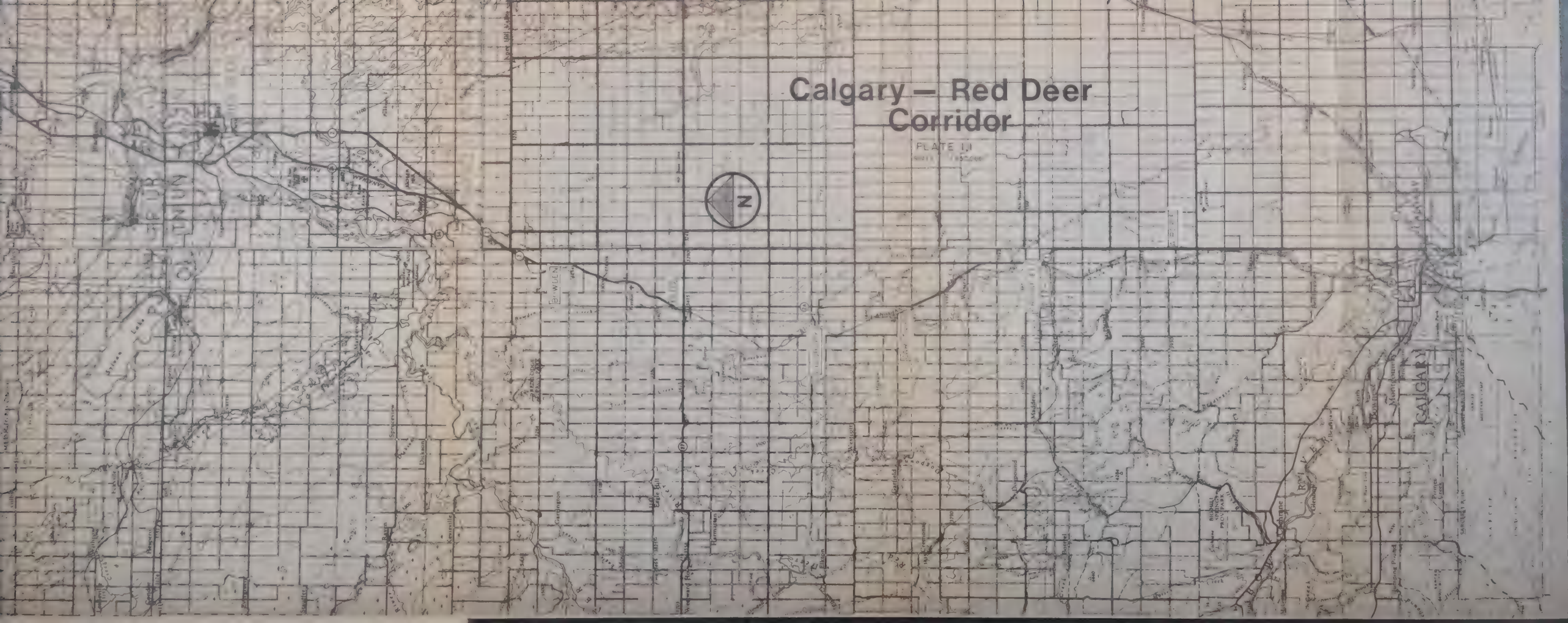
The Government of the Province of Alberta, through the Municipal Engineering Branch of the Department of the Environment, retained Underwood McLellan & Associates Limited in June of 1974 to carry out an engineering study on sewage treatment and disposal for the communities in the corridor between Calgary and Red Deer as illustrated on Plate 1.1. Accordingly, Underwood McLellan & Associates Limited were retained to:

- \ i) Inventory the existing sewage treatment facilities for the communities in the Calgary - Red Deer Corridor, particularly Innisfail, Bowden, Olds, Didsbury, Carstairs, Crossfield and Airdrie.
- ii) Review and assess existing data with respect to:
 - a) growth trends;
 - b) prospects of industrial growth;
 - c) the Red Deer River - Airdrie corridor water study;

- d) existing treatment works and disposal;
 - e) operating problems on existing works;
 - f) operating and maintenance costs on
existing works;
 - g) existing debenture information;
 - h) present service charge by-laws;
- iii) Review the existing treatment system and various alternatives including irrigation with respect to population and industrial growth, and the Department of the Environment existing and proposed standards.
- iv) Investigate the feasibility of staging expansion.
- v) Estimate costs for recommended treatment systems and economic consideration relating to phasing, financing, grants, growths, existing debenture debt and typical payback under present systems of grants and estimated population growths.

Calgary — Red Deer Corridor

PLATE I, I
1911 1950



1.1 Background Information

Base information and parameters which were used in this preliminary engineering appraisal were supplied by the corridor communities; the Calgary Regional and Red Deer Regional Planning Commissions; the Department of the Environment; and from our own files. For analysing this information and these parameters, the methodologies employed were common to all seven communities in the corridor and therefore a discussion of these common parameters and/or analytical methodologies is warranted.

1.1.1 Population Projections

Population projections can only be completed with a limited degree of certainty.

Therefore, for each community two alternative methods of population projection, based on previous trends, were employed:

- i) Method A - Assume
 - 1) P_1 = latest census population
 - 2) P_2 = population 5 years from P_1
 - 3) x = long-term mean quinquennial

increment
(last 20 years)

4) y = short-term mean
quinquennial
increment (last
5 years)

$$\text{Therefore, } P_2 = P_1 + \frac{(x+y)}{2}$$

Example - Town of Innisfail

Census Year	1951	1956	1961	1966	1971
Population	1417	1883	2270	2531	2474

To determine 1976 etc. population

$$P_1 = 2474$$

$$x = (466 + 387 + 261 - 57)/4 = 264$$

$$y = -57$$

$$\text{Therefore } P_2 = 2474 + (264 - 57)/2$$

$$P_2 = 2474 + 104$$

$$P_2 = 2578$$

Therefore, population in 1976 is estimated
to be 2578. Similarly, the population
in 1981, 1986, etc., are estimated.

ii) Method B - This method is based on
determining the maximum quinquennial growth
over the last 20 years and assuming that

this growth rate will continue for the remainder of the period under consideration.

Example - Town of Innisfail

Maximum quinquennial growth occurred from 1951 to 1956 (i.e. 466 persons or 33%)

Therefore, 1976 population = 1971

$$\text{population} \times \frac{133}{100} = 2474 \times 1.33 = 3216.$$

Similarly the populations in 1981, 1986, etc., are derived.

In certain cases where neither of the above two projection methods seemed realistic, specifically in light of knowledge indicating unprecedented growth such as may occur in Airdrie, an alternate method of projection was employed.

1.2 General Department of the Environment Standards

The requirements for sewage treatment as set down by the Department of the Environment are based on the receiving waters available for effluent discharge. In areas where adequate dilution water is afforded by the receiving stream at all times of the year, secondary treatment is a sufficient treatment scheme. The alternative to secondary treatment in these areas is seven months storage in lagoons preceded by an anaerobic-aerobic pond system consisting of 4 anaerobics of 2 - 4 days retention each, plus an aerobic pond of about 2 months retention.

Receiving areas where watercourses are dry or almost dry for most of the year other than during spring runoff or heavy rain periods, do not offer this dilution and, therefore, the Department of the Environment requires seven months storage preceded by secondary treatment, or twelve months storage preceded by the anaerobic-aerobic pond system discussed previously.

Application of these Standards on an individual community basis has been included in the discussions of treatment for the individual communities.

1.3 Alternative Sewage Treatment and Disposal Methods

1.3.1 Irrigation

As part of the terms of reference of this study, the alternative of irrigation was to be reviewed for all communities in the corridor. After preliminary discussions with D. N. Graveland, who is in charge of irrigation test programs in the Taber area and is involved in the investigation of soil amenability and water quality to irrigation in the corridor area and, with individuals in the Department of the Environment, (Standards and Approvals Division), the following information was arrived at for review of feasibility of irrigation for the corridor communities.

- i) Application rates of treated sewage for irrigation are generally between 10 and 14 inches per year. An application rate of 12 inches per year has been assumed in this report (subject to alteration depending on

results of the investigation by
D. N. Graveland) for estimating land
area requirements for irrigation.

- ii) Any irrigation scheme would require a
minimum of 8 to 9 months storage for
irrigation waters preceded by an
anaerobic-aerobic system of about
2 months retention.

In cases where the Department of the
Environment requires a seven months storage
lagoon system (that is, seven months
preceded by 4 anaerobic ponds of 2 - 4
days retention each, and an aerobic pond
of about 2 months retention), the alternative
disposal means of irrigation would still
require this holding capability plus the
irrigation land and equipment. Similarly,
irrigation is an addition to all treatment
alternatives considered except a one year
storage lagoon system. In this case,
irrigation land and equipment can be
considered as an alternative to the last
3 - 4 months storage.

Some of the factors which must be considered in an in-depth evaluation of irrigation as an acceptable disposal means are:

- i) water suitability for irrigation;
- ii) land suitability in the area;
- iii) land availability in the area;
- iv) purchase of land to guarantee access to such land for irrigation;
- v) administration costs of an irrigation program;
- vi) irrigation equipment capital and operating costs;
- vii) increased revenue generated from crop production after irrigation.

The consideration of these factors is beyond the scope of this report, and therefore for the purposes of this report, irrigation is considered as a future possibility and land area requirements only have been indicated for the various communities. Land and water suitability for irrigation is presently under investigation for the corridor communities by the Department

of the Environment.

1.3.2 Joint Treatment

Joint sewage treatment facilities for all the corridor communities or any combination of the communities (other than Airdrie) while not discussed in this report, was considered. Preliminary analysis of this alternative ruled out the feasibility of such a scheme or schemes due to the distances (10 - 16 miles) between communities and the costs of pipe-lining these distances. The cost savings (if any) by joint treatment would not offset the additional capital and operating costs of the pipeline and lift station(s).

1.4 Site Restrictions

Due to the nature of the various treatment process systems evaluated, some restrictions are imposed. Although no particular site has been recommended for most of the communities (other than to keep as close as possible to existing sites to minimize pipe-lining), there are certain factors which must be considered when selecting a site. These restrictions are recommended standards only and, are not absolute unless indicated otherwise.

- i) ponds or lagoons should be located at least one-half mile from the Town boundary;
- ii) ponds or lagoons shall be not less than 1,000 feet from any residences;
- iii) the location shall be not less than 100 feet and preferably 300 feet from any road or railway;
- iv) the toe of the outside berm shall be not less than 20 feet from any property line.

1.5 Costs and Financing

The cost estimates for treatment and disposal facilities for communities in the corridor were all based on estimated 1975 construction and land acquisition costs (1974 costs plus 10%).

Since 1965 the Federal Government under Part VIB of the N.H.A. has made funds available for financing trunk sewers and sewage treatment facilities, and recently a portion of the collection system has become eligible for these funds. Under the program, through C.M.H.C., a municipality may borrow up to $\frac{2}{3}$ of the total approved cost with 25 percent of this amount to be returned as a grant. This effectively amounts to a grant equal to $\frac{1}{6}$ of the project cost. The C.M.H.C. program is currently scheduled to terminate March 31, 1975.

The Province of Alberta initiated a Municipal Sewage Treatment Assistance Program in 1973. This is not a grant program but rather an assistance program to ease the debt burden. The policy under the program is to provide yearly assistance equal to the difference between the total current

debenture cost of a municipality for all its sewage treatment capital costs, and \$13.76 on a per capita basis. The maximum allowable assistance is up to a capital expenditure of \$750.00 per capita amortized at the going rate less \$13.76. Any expenditures over this \$750.00 are the responsibility of the municipality. Such assistance will be carried by the Province on an interest free basis. Conversely, as the population of the municipality increases so that the then current per capita debenture maintenance drops below the predetermined amount of \$13.76, then the municipality shall return to the government, on an annual basis, the difference on a per capita basis until the municipality has returned all the assistance back to the government, or until the debenture is retired.

The pertinent point here is that in any one year a municipality would pay, in debenture debt for sewage treatment, no more than the equivalent of \$13.76 per capita, including existing debenture charges for treatment works, up to the maximum allowable assistance expenditure equivalent to

\$750.00/capita. Assuming the interest rate for debentures to be 10%, then for any debenture expenditure up to \$82.63/capita/year, the municipality would pay only \$13.76/capita/year.

For the purposes of this study, it has been assumed that the C.M.H.C. program will have terminated before the communities in the corridor will be in the position to finance their treatment works.

However, it should be noted that in the event that the C.M.H.C. program is still operating when the communities look for financing, considerable savings would be realized by financing under C.M.H.C.

2. TOWN OF AIRDRIE

2.1 Growth Trends

Present Population (1971) and selected levels of population on which to base engineering plans.

Census Year	1951	1956	1961	1966	1971
Population	275	327	524	778	1089

The population projections based on previous trends do not seem realistic for the Town of Airdrie for the following reasons:

- i) proximity of Airdrie to Calgary
- ii) corridor water supply line

These two factors coupled with the potential annexation of Airdrie by the City of Calgary at some future date indicate that the growth of Airdrie will probably be unnatural compared with normal community growth. Therefore, an optimistic forecast of 20% growth per year until 1986 followed by 8% growth per year for the remainder

of the forecast will be used for the purposes
of this report.

Year	1971	1976	1981	1986	1991	1996	2001
Population	1089	2178	4356	8712	12197	17076	23906

2.2 Photography and Contours

High level air photographs of Airdrie and surrounding area (Plate 2.1) were supplied to Underwood McLellan & Associates by Midwest Surveys and Machair Surveys from their air photo libraries. Contour maps of the area surrounding Airdrie (Plate 2.2) were reproduced from Geological Survey of Canada, Department of Energy, Mines and Resources maps supplied through the Alberta Department of Lands and Forests.

2.3 Sanitary Sewerage System

2.3.1 General Description

The Town of Airdrie is serviced by conventional means, that is, an underground system of collection mains employing gravity flow to an outfall line.

The outfall conveys all collected sewage to the sewage lagoon site (as shown in Plate 2.3) where, due to grade considerations, a lift station is located. Total flows are then pumped into the lagoon system for treatment. All collection mains are 8 inches in diameter. The outfall is a 10 inch diameter line.

2.3.2 Existing Sewage Works

- i) Influent Sewer - This is a 10 inch diameter line up to the lift station. The line is at an average grade of 0.22% and has a nominal design capacity of 1.03 cfs (386 gpm).



TOWN OF AIRDRIE

AIR PHOTOGRAPH
SCALE: 1" = 2640'



TOWN OF AIRDRIE

EXISTING SEWAGE TREATMENT LAGOON SYSTEM
SCALE: 1" = 2640'

- ii) Lift Station - The lift station at the lagoon site is a Chicago Pump Flush Kleen unit. It was recently modified at which time a manhole-type wet well was constructed upstream of the station and, one of the existing 100 USgpm pump units was replaced by a new unit rated at 300 USgpm at a total dynamic head of 52 feet. Sewage is pumped from the lift station to the nearby lagoon via a 4 inch force main.
- iii) Sewage Lagoons - The existing sewage treatment facilities consist of two aerobic lagoons operating in series. These were designed in 1964 at which time the per capita water consumption was 32 gcd. Also, the Department of Health's requirement was for a minimum of six months retention. Both cells were constructed to a depth of 7 feet, with cell No. 1 and cell No. 2 having surface areas of 2.3 acres and 2.0

acres respectively. The approximate total design volume provided by the lagoons is 6,850,000 gallons (i.e. 1175 persons at 32 gpd - 6 months storage).

2.3.3 Outfall and Receiving Area

The discharge from the lagoons is directed into Nose Creek, an intermittent low volume stream which eventually discharges into the Bow River. The available dilution as afforded by natural flows in Nose Creek is limited other than during periods of spring runoff.

2.3.4 Works Operating Problems

The operating problems of a lagoon are minimal in most circumstances with major problems being occasional odours and associated fly and mosquito problems. Insufficient storage capabilities due to increasing per capita water usage, unprecedented growth, low receiving water

flows, and more stringent environmental regulations are of course the major problems facing the Airdrie lagoon system.

2.3.5 Works Operating and Maintenance Costs

The operating and maintenance costs of the Airdrie lagoon system are primarily those costs incurred in routine lift station operation. The lagoons themselves require minimal maintenance related only to keeping the outfall in working order and the checking of berm walls for erosion and leakage. The annual operating and maintenance costs are about \$5,000.

2.3.6 Debenture Information

The outstanding debentures for sewage treatment were issued in 1970 for a period of 25 years. At an interest rate of $8\frac{1}{2}\%$ the annual payment on the original loan amount of \$75,000 is \$7,328.38.

2.3.7 Service Charge By-Laws

The sewer service rates are \$5.50 per two months for residential users, and are 1/2 the water billing for industrial users.

Income from sewer service charges in 1973 was \$13,058.65

Sewer Service Charges

2 Month Figures for Water and Sewer

	<u>Water</u>	<u>Sewer</u>
To 6000 Gallons	\$12.00	\$5.50
Over 6000 Gallons		
100 - .13		
200 - .26		
300 - .38		
400 - .51		
500 - .63		
600 - .76		
700 - .89		
800 - 1.00		
900 - 1.14		
1000 - 1.27		
2000 - 2.50		
3000 - 3.75		
4000 - 5.00		
5000 - 6.25		
6000 - 7.40		
7000 - 8.55		
8000 - 9.70		
9000 -10.85		
10000 -12.00		
Bal. @ \$1.00 per 1000		

Commercial sewer @ 50% of water billing

2.4 Sewage Treatment Requirements for Future Development

2.4.1 Department of the Environment Standards

The present Department of the Environment Standards regarding treatment and discharge of sewage as applied to the Town of Airdrie call for secondary treatment followed by seven months storage or one year storage in lagoons. Recent communication with the Department of the Environment has resulted in the probable future criteria of piping sewage to Calgary (July, 1974).

2.4.2 Alternatives for Sewage Treatment & Disposal

The alternatives available to Airdrie for treatment and disposal of sewage are:

- i) Secondary treatment plus 7 months storage;
- ii) 12 months storage;
- iii) 8 - 9 months storage plus irrigation;
- iv) storage, pumping, and pipeline facilities to discharge untreated sewage to the Calgary sewage collection and treatment system.

In 1972 Underwood McLellan & Associates Limited were retained by the Village of Airdrie to evaluate treatment alternatives. A summary letter indicating the results of this study was sent to the Department of the Environment on October 31, 1972 and the text of this letter follows directly:

Department of the Environment
Government of Alberta
Standards and Approvals Division
Milner Building
10040 - 104th Street
Edmonton, Alberta

Attention: Mr. R. N. Briggs, M.Sc., P. Eng.

Dear Sirs:

"Re: Town of Airdrie - Sewage Treatment

Further to our recent telephone conversation, please be advised that we have completed a preliminary assessment of sewage treatment requirements for the Town of Airdrie. In order to meet the stipulation of 8 to 10 months storage (i.e., limited discharge to Nose Creek), the calculated pond requirement approximates ten acres for each 1000 persons served on the basis of 70 gpd and a ten foot liquid depth. The equivalent loading is some fifty percent of the accepted design value for aerobic ponds and would be reduced further by pretreatment afforded by short detention anaerobic lagoons.

Carrying the above concept further, we find that the first potentially available area is one-half mile south of the existing

lagoons. This parcel comprises some 40 acres and after development thereon, the net water area would be some 30 acres. This, in effect, would provide storage for flows from some 3000 persons as compared to the suggested design population of 5000 persons. The cost of totally developing this area to provide for 3000 persons approximates some \$200,000+ including anaerobic cells on the existing site, inter-connecting pipeline, effluent line, etc. In order to accommodate flows from a population greater than 3000 persons, the next potential land area lies a further one mile to the south (i.e., 1.5 miles south of the existing site). Development costs on this basis are approximately in direct proportion to population served.

Extending the above analyses, and attempting to provide storage as a first premise for future populations, leads us to conclude that lagoon storage as a form of effluent control in this particular instance is neither satisfactory nor acceptable. Our comments are as follows:

1. The Town of Airdrie, while the present population is only some 1200 persons, is a designated growth centre due to its proximity to Calgary. The impact of this is most evident considering the 4:1 ratio between the suggested design population of 5000 and the existing population of 1200.
2. There is at present a significant trend towards the development of acreage holdings on those lands between Airdrie and Calgary.
3. Perpetuating a storage lagoon system in this area would, therefore, be in direct conflict with Item (2) as a large area would, or could, ultimately be devoted to lagoons. In addition

to land requirement, the possibility of offensive odours emanating from large cells during the turnover period must be recognized as unacceptable.

4. Available dilution as afforded by natural flows in Nose Creek is limited. Consequently, if a receiving water criterion has been applied, the effluent discharged from the holding ponds would have to be progressively upgraded. This latter requirement would be directly reflected by substantial capital expenditures.
5. The Town has to date attempted unsuccessfully to acquire two or three separate land areas which were previously recommended on a first basis for lagoons. The only remaining alternatives are acquisition at an exorbitant price or acquisition by expropriation. Considering the potential land areas involved, neither one of these alternatives is truly acceptable for the intended purpose.
6. Considering the junction of Nose Creek with the Bow River, Nose Creek sewage flows would appear to be essentially diverted in total by the diversion dam to Chestermere Lake.

We have, therefore, on the basis of this preliminary analysis, recommended to the Town of Airdrie that they pursue the possibility of utilizing a pipeline to transfer sewage flows to the City of Calgary's sewage collection system. Recognizing the possible merits of this scheme as a long term solution, Airdrie Town Council concurred with our recommendation.

The first phase of the complete evaluation of this solution entails securing approval in principle from the Department of the Environment, C.M.H.C. and the City of Calgary.

Approval, at this stage, from your Department is paramount since the construction of the pipeline and ancillary facilities would fall within the assistance guidelines of the recently established Municipal Sewage Treatment Assistance Program. On a very preliminary basis, a pipeline of 13 to 15 miles would be required depending upon the specific point of tie. This and related works would cost some \$500,000 to \$600,000. Assuming the latter to be applicable and applying the existing debenture debt of \$20/capita, a capital limitation of \$150, an interest rate of 8% and a term of 25 years, the initial assistance would approximate \$41,600 annum. This is exclusive of any C.M.H.C. grants, which would serve to reduce the initial annual assistance to \$32,200. At a population of approximately 4000 persons, the income equals the total debenture payment (correcting for the existing \$20 (capita debt) and the required level of assistance would be zero.

We trust you will view this recommendation as a long term solution to the increasingly difficult problem of sewage disposal from the Town of Airdrie and, on behalf of the Town of Airdrie, we therefore request your approval in principle of the proposed scheme and eligibility under the Municipal Assistance Program.

Thanking you, we are

Yours very truly,

UNDERWOOD McLELLAN & ASSOCIATES LIMITED

Per: K. J. Brisbin, P. Eng.

c.c. Town of Airdrie"

Subsequent to this above mentioned study,

the Village of Airdrie and the Calgary Regional Planning Commission retained the UMA Group to assess the long-term growth potential for the Village of Airdrie. Recommendations from this report released in January, 1974 again indicated the desirability of a sewage pipeline to Calgary as a long-term solution to sewage treatment.

To size alternative treatment schemes for the purpose of comparison over a design period of 25 years, it is assumed (based on improved water supply facilities) that initial water consumption will be 60 gallons per capita per day (gcd) and that this consumption will increase at about 1 gcd per year until a consumption of 75 gcd at which time it will remain constant. It is also assumed that no major wet industry will locate in Airdrie and tie-in to the sewage system, however, an allowance of 50,000 gpd will be made for industrial park wastewaters (30,000 gpd initially and 50,000 gpd after 1986). Any

scheme involving lagoon construction will require a pipeline to a new lagoon site as the existing site will probably be abandoned due to its location close to Airdrie and the path of Airdrie's growth.

For estimating lagoon acreage requirements, it is assumed that lagoon construction is based on a 10 foot water depth for holding lagoons, a 5 foot water depth for aerobic lagoons, a 9 foot water depth for anaerobic ponds, and average construction of 3/1 interior and exterior sidewalls for all lagoons.

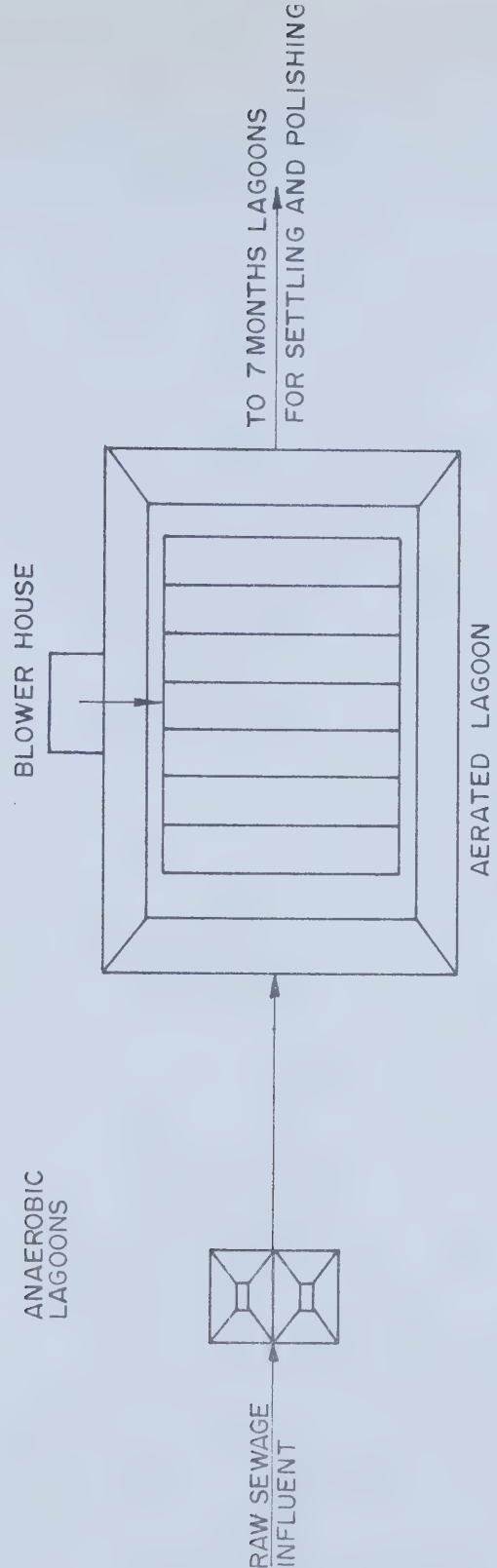
- i) Secondary treatment followed by seven months storage in lagoons would require a substantial increase in the present lagoon system capacity. The lagoon volumes required would total 387 million gallons by the year 2000 and would cover about 171 acres.

Year	Population	Water Consump- tion (gcd)	Indus- trial Park MGD	Daily Flows MGD	7 Month Holding Capacity MGAL	Staged MGAL	Expansion Acres
1975	1960	60	.03	.148	31	66	31
1981	4356	65	.03	.313	66	72	32
1986	8712	70	.05	.640	138	64	28
1991	12197	75	.05	.965	202	77	34
1996	17076	75	.05	1.331	279	108	46
2001	23906	75	.05	1.843	387		

Secondary treatment alternatives to precede the seven months storage are conventional activated sludge, extended aeration, and aerated lagoons. The aerated lagoon is the simplest system and the system with the least operating costs and problems for a community of this size. An unlined aerated lagoon system will be considered for this report and is illustrated in Plate 2.4.

The ratio of flows for the next 25 years to present flows is in the order of 15/1 and therefore an aerated lagoon should not be designed to handle flows too far in the future. Therefore staged aerated lagoons,

NOTE: Volume = (5) 4 x 10⁶ Gallon Basins
Approximate Dimensions (each)
300' x 400' x 10' Depth



TOWN OF AIRDRIE
SCHEMATIC FLOW DIAGRAM
OF
AERATED LAGOON ALTERNATIVE

each having capacity for about .300 MGD, will be considered. To provide an average retention of 12 days at design capacity, five staged aerated lagoons of 3.5 - 4.0 million gallons capacity each will be required. Each lagoon will require sufficient aeration horsepower for mixing and oxygen supply. The oxygen requirement can be met by approximately 20 hp of aeration equipment but oxygen dispersion and solids circulation requirements dictate the use of about 60 hp per cell (depending on the type of aeration equipment). This could be supplied by 4 x 20 hp blowers (1 on standby).

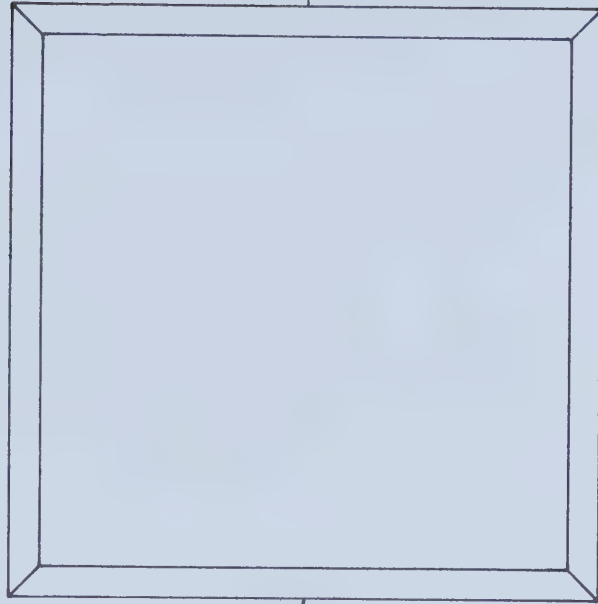
Year	Population	Daily Flow MGD	BOD ₅ Load lbs/day	O ₂ Required lbs/day	lbs./hr.
1975	1960	.148	333	500	21
1981	4356	.313	740	1111	46
1986	8712	.640	1481	2222	93
1991	12197	.965	2073	3110	130
1996	17076	1.331	2903	4354	181
2001	23906	1.843	4064	6096	254

ii) The alternative of 12 months storage in lagoons preceded by an anaerobic-aerobic lagoon system (about 2 months retention) illustrated in Plate 2.5, would require a total volume of 794 million gallons or 396 acres of land.

Year	Population	Water Consumption (gcd)	Daily Flows MGD	Anaerobic Aerobic Treatment Lagoons MGAL	12 Month Holding Capacity MGAL	Total MGAL	Acreage Total Acres	Required Staged Acres
1975	1960	60	.148	9	56	65	35	70
1981	4356	65	.313	19	115	134	76	73
1986	8712	70	.640	42	241	283	143	66
1991	12197	75	.965	62	352	414	209	80
1996	17076	75	1.331	87	486	573	289	107
2001	23906	75	1.843	122	672	794	396	

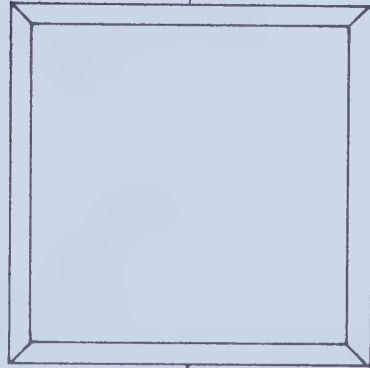
iii) The alternative of irrigation may not be feasible as a long range solution due to the problems of land availability for storage lagoons and irrigation in the Airdrie vicinity. Irrigation would require almost 2 sections of land by 1990 and almost 4 sections of land by

ONE YEAR HOLDING LAGOONS

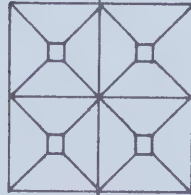


EFFLUENT TO
NOSE CREEK

AEROBIC LAGOON



ANAEROBIC
LAGOON



RAW SEWAGE
INFLUENT

TOWN OF AIRDRIE
SCHEMATIC FLOW DIAGRAM
OF
ONE YEAR STORAGE ALTERNATIVE

2000. A study by H. F. Regier, Technical Development Branch of Alberta Environment entitled "Airdrie Area Soil Capability for Utilization of Sewage Effluent by Spray Irrigation" indicated that irrigable land is available about one half to three quarters of a mile east of No. 2 Highway. Approximately 2 sections have been classified as irrigable and a large area as potentially irrigable. The elevation of this land ranges from about 100 to 150 feet above the existing Airdrie treatment system. Therefore a lift station would be required to transfer treated sewage to this site for irrigation or to transfer untreated sewage to this site for treatment, holding, and irrigation. It would also be possible to continue in a southerly direction from the existing lagoons for further lagoon treatment and storage as well as irrigation. Plate 2.6 illustrates potential sites for lagooning and irrigation.

Year	Daily Flow MGD	Anaerobic-Aerobic Treatment Lagoons			8 Months Storage Lagoons			Irrigation Land	
		Total MGAL	Staged MGAL	Acres	Total MGAL	Staged MGAL	Acres	Total Acres	Staged Acres
1975	.148	9	19	18	35	75	34	171	361
1981	.313	19	23	20	75	83	37	361	401
1986	.640	42	20	18	158	74	32	762	351
1991	.965	62	25	22	232	88	38	1113	422
1996	1.331	87	35	31	320	122	51	1535	589
2001	1.843	122			442			2124	

iv) The sewage pipeline to Calgary alternative would require pumping the collected sewage approximately 13 miles to tie-in with the City of Calgary's collection system as illustrated by Plate 2.7. The existing lagoon facilities could be used for flow equalization so as to minimize the peak loads in the Calgary collection system. If construction of this pipeline is likely to be delayed for a few years, then the first stage of the 12 month storage lagoon system could be constructed initially as a stop gap measure. Once the pipeline was constructed, these



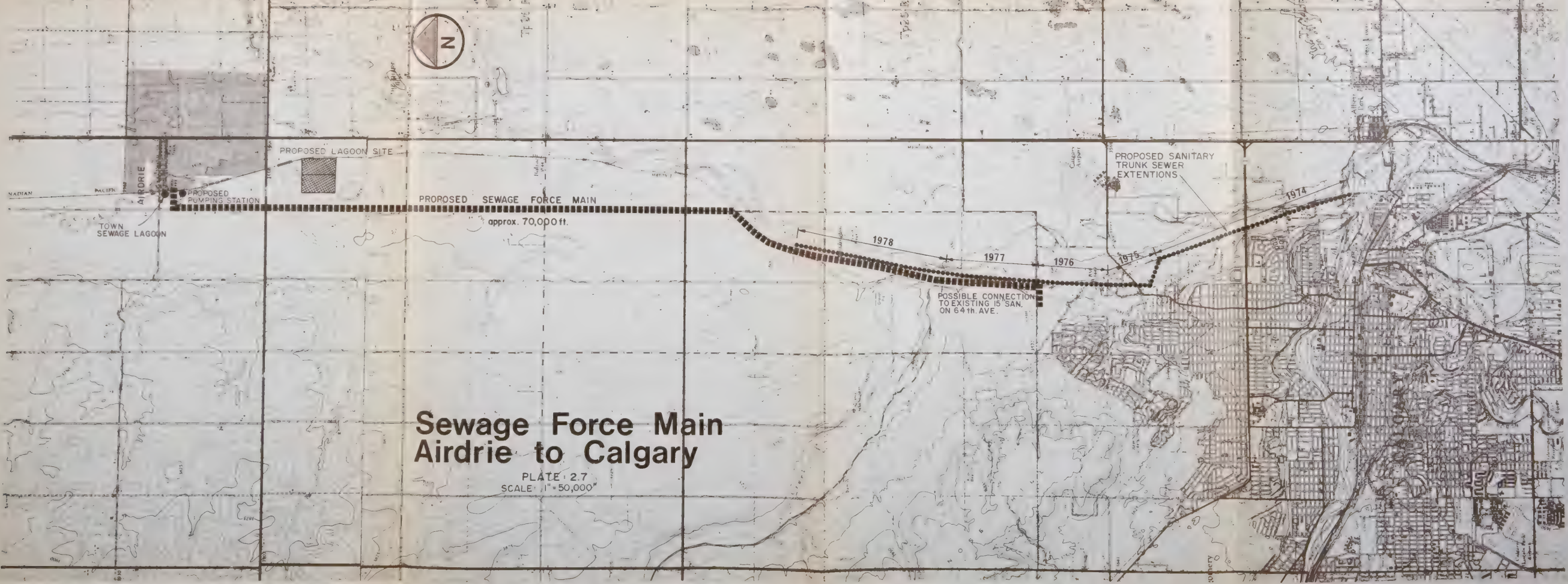
- ① Existing Lagoon Site
- ② ③ Possible Lagoon Sites
- ④ Acceptable Irrigation Site
- ⑤ ⑥ ⑦ Possible Irrigation Sites

TOWN OF AIRDRIE

POSSIBLE SITES FOR LAGOON EXPANSION AND IRRIGATION

SCALE: 1" = 50,000"





Sewage Force Main Airdrie to Calgary

PLATE 2.7
SCALE 1" = 50,000'

lagoons would act as storage lagoons to allow off-peak pumping.

- v) Other alternatives which are possible for the Town of Airdrie but do not fall in directly with the Department of the Environment requirements are: secondary treatment followed by a pipeline to the Bow River bypassing the Calgary collection and treatment system; secondary treatment or better with continued discharge to Nose Creek, or plus four months holding to prevent the formation of ice blockages in Nose Creek and the resultant land flooding during the coldest winter months. In line with our recent discussions with the Department of the Environment it seems technically acceptable to consider secondary treatment plus four months winter holding as sufficient treatment. Land area requirements for these holding lagoons would amount to about 55 acres by 1990 and 101 acres by the year 2000 compared with 7 month

holding and 12 month holding requirements of 91 or 209 acres respectively by 1990 and 171 or 396 acres respectively by the year 2000.

4 Months Holding

Year	Population	GCD	MGD	4 Months MGAL	Staged MGAL	Acres
1975	1960	60	.148	17	37	18 (18)
1981	4356	65	.311	37	42	20 (38)
1986	8712	70	.640	70	37	17 (55)
1991	12197	75	.965	116	44	19 (74)
1996	17076	75	1.331	160	61	<u>27 (101)</u>
2001	23906	75	1.843	221		<u><u>101</u></u>

A further alternative that could be considered would be the separate treatment of the wastewater from the industrial park area. The 30,000 - 50,000 gallons/day from this park could be treated in lagoons (totalling 8 - 12 acres) and disposed of by irrigation (35 - 60 acres) at the site.

Other than for alternatives of immediate

construction of either a pipeline to Calgary or a conventional secondary treatment system, a pressure pipeline to a new treatment site will be required. The first site considered to be acceptable is approximately $1\frac{1}{2}$ miles south of the existing site. The criteria for evaluating whether a site is acceptable are the proximity of the site as discussed in the introduction and the long-term growth plans of the community. With the unprecedented growth potential of Airdrie in mind and the recommendation by the Calgary Regional Planning Commission that this growth be directed towards the south and the west, an evaluation of potential sites for treatment plant relocation resulted in the above mentioned land area being considered as most acceptable.

It should be noted for future consideration that the present outfall line to the lift station is limited in ultimate

capacity and will have to be expanded, probably in about 5 years time if the Town of Airdrie expands northward.

Expansion to the south and west only would require lift stations tying into the force main to the proposed lagoon site.

2.4.3 Costs for Alternative Sewage Treatment and Disposal Schemes

With the land costs in the Airdrie area rapidly increasing, it is difficult to establish the cost of land were it to be available. For the purposes of cost estimating, \$2,500/acre will be used as the cost of land in 1975. Also, 5 year incremental construction of lagoons will be assumed although they will be costed in terms of 1975 dollars.

- i) Seven month storage lagoons built in 1975 will require capacity for sewage flows up to the next construction period (1981).

Lagoon size required	= 60 MGALS.
Acreage	= 28 Acres
Land Costs	= \$70,000
Lagoon Construction Costs	= \$97,930
Clearing, Finishing, Fencing, etc.	= \$16,790
Engineering and Contingencies	= <u>\$27,700</u>
Total	= \$212,420

A pipeline to a new site (1½ miles south) plus modification to the lift station are estimated to cost \$200,000.

The cost of a 3.5 - 4.0 million gallon unlined aerated lagoon system would be about \$75,000 including the lagoon, blower house, and aeration equipment.

The total cost of secondary treatment by aerated lagoons followed by seven months storage in lagoons is estimated to be \$1.9 million to the year 2000 plus almost \$350,000 in operating costs for a total of almost \$2.4 million.

Year	Secondary Treatment Costs	Operating Costs	Lagoon Costs 1975 Dollars	Land Costs	Pipeline & Other Costs	Engineering & Cont.	Total Cost
1975	75,000	4,320	97,930	70,000	216,790	57,700	517,420
1976-80		21,600					
1981	75,000	8,640	111,000	75,000	18,600	30,700	310,300
1982-85		34,560					
1986	75,000	12,960	104,500	70,000	17,450	28,800	295,750
1987-90		51,840					
1991	75,000	17,280	125,700	80,000	20,500	33,900	335,100
1992-95		69,120					
1996	75,000	21,600	176,300	115,000	29,100	48,000	443,400
1997-2001		<u>108,000</u>					<u> </u>
		349,920					1,891,970

Debenturing these costs at 10% for 25 year terms (assuming inflation at 10% per year) would result in an initial annual payment by the Town of Airdrie of \$32.82/capita of which Provincial Assistance would cover \$19.06/capita/year. (\$32.82 - \$13.76).

Year	Population	Total Cost	Debenture Payment	Annual Payment		Existing	Debenture	Total
				\$	\$/capita	\$	\$/capita	\$/capita
1975	1960	517,420	57,003	57,003	29.08	7,328	3.74	32.82
1981	4356	549,700	60,560	117,563	26.99	7,328	1.68	28.67
1986	8712	843,800	92,960	210,523	24.16	7,328	0.84	25.00
1991	12197	1,539,800	169,638	380,161	31.17	7,328	0.60	31.77
1996	17076	3,281,300	361,495	741,656	43.43			43.43

A conventional secondary treatment scheme including aeration, settling, sludge return, anaerobic sludge digestion, and chlorination is estimated to cost about \$2.0 million. This scheme could be staged with one half the plant constructed initially and the other half around 1990. The seven months storage lagoons would increase this amount to \$3.3 million. An extended aeration treatment system including aeration (earthen basin), settling, sludge return, aerobic sludge digestion (earthen basin), and chlorination would cost approximately \$1.5 million and could also be constructed in two stages. Seven months lagoon storage would add another \$1.3 million to this sum for a total of \$2.8 million.

ii) The total estimated capital cost of a one year lagoon system (in 1975 dollars) with adequate capacity for sewage flows to the year 2000 is approximately \$3,094,600.

Year	Land Cost	Lagoon Construction	Pipeline & Other Miscellaneous	Engineering & Contingencies	Total
		1975 Dollars			
1975	175,000	200,600	237,500	91,900	705,000
1981	177,500	235,000	41,200	68,000	521,700
1986	165,000	215,200	38,000	62,700	480,900
1991	200,000	264,800	46,500	76,700	588,000
1996	267,500	364,100	63,200	104,200	<u>799,000</u>
					\$3,094,600

Debenturing these costs at 10% over 25 year terms would result in an initial annual payment of \$43.37/capita less any payment by the industrial park connections for their sewage contribution to the sewage treatment and disposal system.

Year	Population	Total Cost \$	Debentured Payment \$	Annual Payment \$ \$/Capita		Existing \$	Debenture \$/Capita	To \$/C
1975	1960	705,000	77,669	77,669	39.63	7,328	3.74	43.
1981	4356	924,200	101,817	179,486	41.20	7,328	1.68	42.
1986	8712	1,372,050	151,157	330,643	37.95	7,328	0.84	38.
1991	12197	2,701,900	297,664	628,307	51.51	7,328	0.60	52.
1996	17076	5,912,850	651,410	1,279,717	74.94	-	-	74.

iii) The costs of an irrigation scheme are dependent on land areas available for lagoons and irrigation and costs for these land areas. Assuming land cost of \$2500/acre results in a total lagoon cost to the year 2000 of \$2,081,880. If this same land cost is used for irrigation land an additional sum of \$5,310,000 must be added for irrigation land. If purchase of large land areas results in a cost reduction to \$1,500 per acre, the irrigation scheme not including equipment and operating costs would cost \$3,186,000 to the year 2000 for a total system cost of \$5,267,880. Equipment and operating

costs in this area are estimated to
be in the order of \$180/acre.

Year	Lagoon Construction	Land Cost	Other Miscellaneous	Engineering & Contingencies	Total	Irrigation Land Cost
1975	141,980	130,000	27,200	44,800	343,980	902,500
1981	164,850	135,000	29,900	49,400	379,150	1,002,500
1986	153,430	125,000	27,840	45,940	352,210	875,500
1991	189,440	150,000	33,440	55,180	423,060	1,055,000
1996	256,260	205,000	46,120	76,100	<u>583,480</u>	<u>1,472,500</u>
					2,081,880	5,310,000
						(3,186,000)

Additional to this would be a lift
station and pipeline to the irrigation
site. Depending on the length of line
these factors would add \$300,000 -
\$500,000 to the above cost.

- iv) The alternative of piping the sewage
to Calgary to be treated by the City
of Calgary is extremely dependent on
costs and availability of pipe.

The cost of a pipeline to Calgary is
estimated to be \$1,908,300.

Pipe Costs	-	\$1,544,000
Installation Costs		
Easements and Road Crossings	-	35,000
Sewage Lift Station	-	80,000
Engineering and Contingencies	-	<u>248,900</u>
Total		\$1,908,300

The pipeline debentured at 10% over
25 years would require an initial annual
payment of \$210,335 which when corrected
for existing debenture payments and
projected population would amount to

Year	Population	Total Cost \$	Debenture Payment \$	\$/Capita	Existing \$	Debenture \$/Capita	Total \$/Capita
1975	1,960	1,908,300	210,335	107.31	7,328	3.74	111.05
1981	4,356		210,335	48.29		1.68	49.97
1986	8,712		210,335	24.15		0.84	24.99
1991	12,197		210,335	17.24		0.60	17.84
1996	17,076			12.32			

\$111.05/capita of which the provincial government would pay the difference between \$13.76 and \$82.63 or \$68.87/capita. Therefore the total initial annual debenture payment to be paid by the Town of Airdrie would be \$42.18/capita or \$82,673. Around 1978 the increase in population should be sufficient to lower the total annual payment to the \$82.63/capita level at which time the annual payment to be made by the Town of Airdrie would be reduced to \$13.76/capita.

In the event that the decision to construct this pipeline is delayed for a few years (perhaps until 1981) the cost of constructing a stop gap 12 month lagoon system would be \$705,000. This cost would include upgrading the existing lift station, constructing a 1½ mile pipeline to a new lagoon site, and construction of about 70 acres of treatment and holding

lagoons. The pipeline cost would of course increase, due to inflation, and at an inflation rate estimated to be 10% per year, the 1981 cost could increase to \$3,379,600. Provincial assistance would be required for this combined scheme as debenture payments (assuming 10% interest for 25 year terms) are estimated to total \$43/capita initially and about \$100/capita at the time the pipeline is constructed. These per capita payments could be reduced by C.M.H.C. grants, industrial park contribution towards capital repayment, and a lower rate of inflation.

- v) The costs of the other alternative systems mentioned in the preceding section would depend on the method chosen for secondary treatment and better than secondary treatment. For example conventional secondary treatment for a population of 12,000 would cost in the order of \$1.0 million which when added

to the cost of pipeline extended to the Bow River would amount to \$3.4 million. Expanding the plant for a total population of 23,000 would result in total estimated costs to the year 2000 of \$4.4 million.

The alternatives involving better than secondary treatment will not be costed at this point in time, as discussions with the Department of the Environment to review the Airdrie situation and decide what additional treatment, if any, (such as carbon adsorption, phosphorous removal, ultra-filtration, etc.) would be required, resulted in no advanced treatment requirements at this time.

Conventional secondary treatment plus four months storage would be acceptable, and the cost of this alternative would amount to approximately \$2.7 million for the population forecast to the end of the century.

The capital costs of alternative

treatment schemes is summarized
below (in terms of 1975 dollars).

Aerated Lagoons plus 7 months storage in lagoons	\$1,891,970
One year storage in lagoons	3,094.600
Holding lagoons plus Irrigation	5,267,880
Pipeline to Calgary	1,908,300
One year storage in lagoons for a population of 4500 plus a pipeline to Calgary	2,613,300
Conventional secondary treatment plus 4 months storage in lagoons.	2,700,000

2.5 Recommendation

Based on technical only considerations, the construction of a sewage line to Calgary is recommended. This scheme is preferable for the following reasons:

- i) large storage lagoons offer potential odour problems
- ii) large storage lagoons would require substantial land area between Airdrie and Calgary which is in direct conflict to the trend of developing acreage holdings in this area;
- iii) land availability is minimal except at either an exorbitant price or by expropriation;
- iv) available dilution afforded by natural flows in Nose Creek is limited.

The cost of the sewage line to Calgary is estimated to approximate \$1.9 million less CMHC grants and any cost savings resulting from employing standard pipeline construction techniques. Provincial assistance would be required for this scheme.

In the event that this alternative is undesirable at this time, it will be necessary to investigate

in detail the availability of land in the vicinity of Airdrie for development of alternative treatment and disposal schemes all of which involve lagooning.

Following review with the Department of the Environment, the stated preference is for the eventual construction of the pipeline to Calgary to be preceded in the interim by a one year lagoon storage system. This lagoon system would require capacity for sewage flows from a population approximating 4500 plus the sewage flows from the industrial park. Seventy acres of land will be required for these lagoons based on the existing Department of the Environment regulations for Airdrie which stipulate 12 months holding in lagoons following anaerobic-aerobic lagoon treatment. It is our opinion that, considering the quality of Nose Creek, a more reasonable requirement would be 9 months holding and two discharges per year. Also for an interim lagoon system, sewage flows could be based on 50 gcd (present consumption is only 32 - 35 gcd) thereby reducing the lagoon area requirement to 50 acres.

The recommended land area for lagoon construction would be south of Airdrie since this direction is along the natural drainage course, as well as being along the path of eventual disposal to Calgary. Facilities built here would be suitable for later use as surge ponds to permit off-peak pumping to Calgary. Also, facilities south of Airdrie would reduce the eventual length of a pipeline to Calgary thereby reducing costs for this second stage of long-term sewage treatment and disposal for Airdrie.

The result of an investigation (excluding soil analysis) into suitable lagoon sites south of Airdrie indicates the first acceptable land area to be approximately $1\frac{1}{2}$ miles south of the existing lagoons ($E\frac{1}{2}$ $SW\frac{1}{4}$ Sec. 36-26-1-5 and $W\frac{1}{2}$ $SE\frac{1}{4}$ Sec. 36-26-1-5) and the next suitable site a further 1 mile south of this site ($SW\frac{1}{4}$ Sec. 25-26-1-5) (illustrated on Plate 2.8). Possible sites closer to Airdrie have been rejected due to their eventual development as residential areas as recommended by the Calgary Regional Planning Commission, a point on which we concur.

It is recommended that 80 to 160 acres of land be

EXISTING LAGOON
SITE



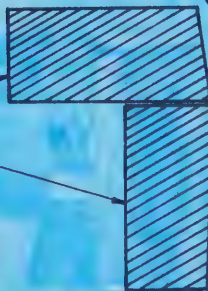
RECOMMENDED
NEW LAGOON SITE



NOSE CREEK



POSSIBLE
ALTERNATE
LAGOON SITES



TOWN OF AIRDRIE
RECOMMENDED SITE
FOR LAGOON
SCALE: 1"=2640'

acquired immediately to allow further lagoon construction at a later date if necessary, and to act as a buffer zone around the lagoon system. The additional land could be rented to farmers. The cost of acquiring 80 acres of land (at \$2500/acre), constructing 50 acres of lagoons, constructing a 1½ mile force main to the site, and modifying the existing lift station are estimated to total approximately \$660,000.

The pipeline to Calgary from this site to tie-in with the Calgary collection system at a point 3 miles north of the possible connection at 64th Avenue indicated on Plate 2.7 (1980 extent of City of Calgary proposed staged sanitary trunk construction up Nose Creek) would be reduced in cost from an estimated \$1.9 million to \$1.3 million. This estimated cost however, would increase with inflating material and manpower costs to approximately \$2.3 million by 1981 (assuming inflationary trends to continue at 10% per year).

Based on \$660,000 for construction of the first stage, an interest rate of 10%, a term of 25 years, existing

debenture debt of \$7,328/year, and a capital limitation of \$13.76/capita/year, the initial assistance (assuming an initial population of 1500) would approximate \$59,400 (\$39.60/capita/year).

At a population of 4500 the annual assistance would have decreased to less than \$4/capita/year.

Construction of the second stage (i.e., the pipeline to Calgary) at this time (about 1981) and assuming the above conditions to remain the same, the required assistance would approximate \$271,500/year (\$60.33/capita/year). As the population of Airdrie approaches 24,000 the required provincial assistance would approach zero. If C.M.H.C. funds are still available at the time of construction of the recommended systems, the required assistance figures would be reduced by the amount of the grants.

3. VILLAGE OF CROSSFIELD

3.1 Growth Trends

Present population (1971) and selected levels of population on which to base engineering plans.

Census Year	1951	1956	1961	1966	1971
Population	443	459	593	582	638

The average quinquennial population projection method seems most realistic for forecasting the growth trends of Crossfield. It is anticipated that the corridor water supply line will have minimal impact on the potential for industrial growth in Crossfield and thus population growth will only be that due to natural migration. Therefore, a rate of growth of 2% per year, which closely approximates the quinquennial population projection, will be used in this report.

Year	1971	1976	1981	1986	1991	1996	2001
Population	638	702	772	849	934	1028	1130

3.2 Photography and Contours

High level air photographs of Crossfield and surrounding area (Plate 3.1) were supplied to Underwood McLellan & Associates by the Alberta Department of Highways from photos taken by the Department of Lands and Forests, Aerial Surveys Section. Contour maps of the area surrounding Crossfield (Plate 3.2) were reproduced from Geological Survey of Canada, Department of Energy, Mines and Resources maps supplied through the Alberta Department of Lands and Forests.



VILLAGE OF CROSSFIELD

AIR PHOTOGRAPH
SCALE : 1" = 2640'



VILLAGE OF CROSSFIELD

EXISTING SEWAGE TREATMENT LAGOON SYSTEM

SCALE: 1" = 2640'

3.3 Sanitary Sewerage System

3.3.1 General Description

The Village of Crossfield is serviced by a conventional system of underground collection mains employing gravity flow to an outfall line.

The outfall conveys all collected sewage to the sewage lagoon site as shown in Plate 3.3. Collection mains are 8 inches in diameter. The outfall is a 10 inch diameter line.

3.3.2 Existing Sewerage Works

i) Influent Sewer - This is a 10 inch diameter line up to the lagoons. The line is at an average grade of 0.25% and has a nominal design capacity of 1.05 cfs (393 gpm).

ii) Sewage Lagoon - The sewage treatment facilities for the Village of Crossfield were constructed in 1953. The construction drawing #241-08 prepared by Haddin Davis & Brown indicates two

sewage lagoons, the primary lagoon having 28,000 gallon capacity and the following aerobic lagoon having 630,000 gallon capacity. A rough sketch on this same drawing indicates the aerobic lagoon as having dimensions of 500' x 200' which at a 7 foot depth would give a capacity of about 3.3 million gallons.

Contained in a 1970 report for the Village of Crossfield, Associated Engineering indicated that calculations based on aerial photo plotting showed the volume of the primary cell to be 90,000 gallons and the volume of the aerobic cell to be 6 million gallons.

Based on Associated Engineering's calculations and the notation that these assumed figures must be varified before any design additions or modifications are carried out, the

present holding time of the lagoon system at a 1973 population of 653 and a water usage rate of 52 gpd, would be about 179 days or almost six months.

3.3.3 Outfall and Receiving Area

The discharge from the lagoons is directed into Nose Creek which is an intermittent stream affording very limited dilution other than during periods of spring runoff.

3.3.4 Works Operating Problems

No operational problems have been encountered with the Crossfield lagoon system other than insufficient capacity. The lagoon was drained twice in the spring of 1974 due to high runoff conditions.

3.3.5 Works Operating and Maintenance Costs

There are no reported operation and maintenance costs incurred for the Crossfield system. The lagoon is checked by the water reservoir

and supply operating personnel who also look after draining the lagoon when the level is high. No maintenance on the lagoon is performed.

3.3.6 Debenture Information

The sewage treatment system debenture was retired in 1973. There have been no debentures issued for sewage treatment works since the original system was constructed.

3.3.7 Service Charge By-Laws

The service charge by-law of water and sewer rates for the Village of Crossfield was passed by Council in 1969. The individual charges are summarized below. The normal single family dwelling is charged \$6.00 bi-monthly for sewer connection. The income from sewer service charges in 1973 was \$9,356.44

Sewer Service Charges

(1)	dwellings per family . . .	\$6.00 - bi-monthly
(2)	apartments per unit	6.00
(3)	stores and offices	6.00
(4)	hotels	60.00
(5)	restaurants	16.00
(6)	schools	120.00
(7)	Senior Citizen's Lodge .	120.00
(8)	Community Halls	11.60
(9)	Trailer Court	57.60

3.4 Sewage Treatment Requirements for Future Development

3.4.1 Department of the Environment Standards

The Department of the Environment Standards as they apply to the Village of Crossfield require one year storage in lagoons or seven months storage in lagoons following secondary treatment.

3.4.2 Alternatives for Sewage Treatment and Disposal

Based on Department of the Environment Standards there are three major alternatives for sewage treatment and disposal for the Village of Crossfield. The alternatives are twelve months storage in lagoons, seven months storage in lagoons following secondary treatment, or 8 - 9 months storage in lagoons followed by irrigation.

The design basis for new treatment facilities has been assumed as follows:

Water consumption and Wastewater Flow

- Present -- 52 gcd

- 1975 - 60 gcd

Increases at 1 gcd/year until 75 gcd
is reached and then stays at 75 gcd.

BOD₅ load -- 0.17 pounds/day/capita.

Lagoon depths - anaerobic 9 feet

aerobic - 5 feet

holding &
aerated - 10 feet

- i) Twelve months storage for the sewage flows from the Village of Crossfield will require probable relocation of the treatment system.

The present site is limited for expansion and is extremely close to the water supply storage system which could present a health hazard. On this basis the new lagoon system to be constructed would consist of 4 anaerobic ponds followed by aerobic ponds followed by holding ponds

(see Plate 3.4).

The total holding requirements are as follows:

Year	Population	Water Consumption GCD	Anaerobic Aerobic Treatment Lagoons MGAL	Holding Lagoon MGAL	Total Volume MGAL
1975	688	60	3.3	15	18.3
1981	772	65	3.7	18	21.7
1986	849	70	4.4	22	26.4
1991	934	75	5.2	25	30.7
1996	1028	75	5.4	28	33.4
2001	1130	75	5.9	31	36.9

Based on 4 days retention initially for each of the 4 anaerobic ponds (this will decrease to an average of 2 days each by the year 2000), each anaerobic pond will have capacity approximating 170,000 gallons for a total anaerobic capacity of 680,000 gallons.

The aerobic lagoon construction can be staged for purposes of delaying

NOTE: Existing Capacity - to be Determined
Required Capacity by 2000 - 37×10^6 Gallons
Additional Land Area - 30 Acres

ONE YEAR HOLDING LAGOONS

AEROBIC LAGOON

ANAEROBIC
LAGOONS

RAW SEWAGE
INFLUENT

EFFLUENT TO
NOSE CREEK

VILLAGE OF CROSSFIELD

SCHEMATIC FLOW DIAGRAM

OF

ONE YEAR STORAGE ALTERNATIVE

capital expenditure and for verification of forecasts of growth.

To accomplish this staging, it will be assumed that lagoons with a total capacity of 22 million gallons will be constructed initially with the addition of a 9 million gallon lagoon in 1981 and a 6 million gallon lagoon in 1991 for a total of 37 million gallons.

	Lagoon Sizing <u>MGAL</u>	<u>Acres</u>
1975	22	18
1981	9	7
1986		
1991	6	5
1996		

- ii) Seven months storage following secondary treatment is the second alternative for treatment for the Village of Crossfield. Capacities required for seven months storage

are as follows:

Year	Population	Water Consumption GCD	Lagoon Volumes MGAL
1975	688	60	8.7
1981	772	65	10.5
1986	849	70	12.5
1991	934	75	14.7
1996	1028	75	16.2
2001	1130	75	17.8

It will be assumed that complete new lagoon construction will be carried out.

Therefore, a staged construction of new lagoons as follows will be assumed:

Year	New Lagoon Sizing MGALS	Acres
1975	10	7
1981	5	4
1986		
1991	5	4
1996		

The alternatives for secondary treatment, preceding seven months storage are; aerated lagoon, activated sludge (conventional) and, extended aeration (package plant). However, for the purposes of this report only an aerated lagoon system will be evaluated due to lower costs and minimal operational problems.

The loading to the secondary treatment plant is estimated to approximate the following:

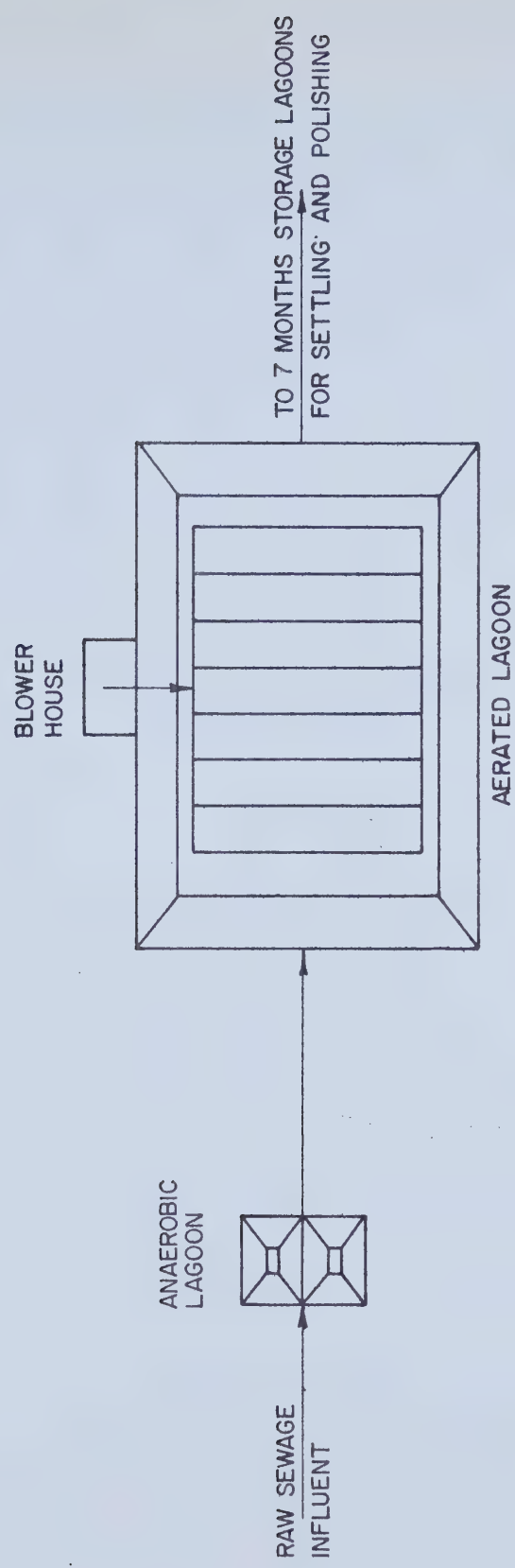
Year	Population	Water Consumption GCD	Daily Flow MGD	BOD ₅ lbs/day	O ₂ Requirement lbs/day	lbs/hr.
1975	688	60	.041	117	175	7.3
1981	772	65	.050	131	197	8.2
1986	849	70	.059	144	216	9.0
1991	934	75	.070	159	238	10.0
1996	1028	75	.077	175	262	11.0
2001	1130	75	.085	192	288	12.0

An aerated lagoon of 1.0 million gallon capacity will provide about

25 days retention initially decreasing to about 12 days retention by the year 2000 (see Plate 3.5). At 10 foot water depth this lagoon would occupy about 1.5 acres of land. The horsepower requirements for oxygen would be in the 4 - 6 hp range, but to provide adequate oxygen dispersion and solids circulation, about 20 hp will be required. This could be supplied by 3 x 10 hp blowers allowing for 1 standby unit. There would be little advantage to staging subsurface aeration equipment for this lagoon.

- iii) The third alternative is that of 8 - 9 months storage followed by irrigation. The 8 - 9 months storage would be in addition to 4 anaerobic ponds of about 2 - 4 days retention each plus an aerobic pond of about 2 months retention. Land required for irrigation is based on an assumed application rate of 12 inches per year.

NOTE: Volume ~ 1.0 x 10⁶ Gallons
Approximate Dimensions
260' x 200' at 10' Depth



VILLAGE OF CROSSFIELD
SCHEMATIC FLOW DIAGRAM
OF
AERATED LAGOON ALTERNATIVE

Year	Population	GCD	Lagoons MGAL	Staged MGD	Lagoon Acres	Irrigation Total Acres	Land Stages Acres
1975	688	60	13.1	16	14	55	67
1981	772	65	15.7	6	5	67	13
1986	849	70	18.6			80	14
1991	934	75	21.7	5	4	94	10
1996	1028	75	23.8			104	10
2001	1130	75	26			114	

3.4.3 Costs of Alternative Sewage Treatment and Disposal Schemes

Due to the probable necessity of relocating the treatment system, it will be assumed for these cost estimates that a 1/4 mile gravity pipeline is sufficient. While the cost of this line has been included in the estimates a cost reduction or increase could be applicable, depending on the exact location of the treatment system.

It has also been assumed that 1975 land costs in the Crossfield area will approximate \$400/acre.

i) The staged costs of a twelve months storage scheme are estimated to total \$116,540 with the breakdown to approximate the following:

Year	Lagoon Size MGAL	Lagoon Costs	Land Costs	Other Costs	Engineering Plus Contingencies	Pipeline	Total
----- 1975 Dollars -----							
1975	22	35,910	7,200	4,310	7,100	25,000	79,520
1981	9	14,690	2,800	1,750	2,900		22,140
1986							
1991	6	9,790	2,000	1,150	1,940		<u>14,880</u>
							116,540

To debenture these loan amounts at a 10% rate of interest over a 25 year term, initial annual payments of \$8,761 would be required. No Provincial Government assistance would be applicable until 1981 when the annual payments rise to over \$13.76/ capita assuming this criteria to be still in effect for Provincial assistance.

Year	Population	Total Cost \$	Debenture Payment \$	Total Annual Payment \$	\$/Capita
1975	688	79,520	8,761	8,761	12.73
1981	772	39,200	4,319	13,080	16.94
1986	849			13,080	15.41
1991	934	68,360	7,531	20,611	22.07
1996	1028			20,611	20.05
2001	1130			11,850	10.49

ii) The costs of a secondary treatment system followed by a staged seven months lagoon storage are estimated to total \$114,600 in capital costs with operating costs to the year 2000 amounting to \$38,880 for a total of \$153,480.

Year	Secondary Treatment Costs	Operating Costs	Pipeline Costs	Lagoon Costs	Land Costs	Other Costs	Engineering and Contin- gencies	Total Capital Cost
----- 1975 Dollars -----								
1975	30,000	1440	25,000	16,320	4,000	2,000	11,600	88,920
1976-80		7200						
1981		1440		8,160	2,000	1,000	1,680	12,840
1982-85		5760						
1986		1440						
1987-90		5760						
1991		1440		8,160	2,000	1,000	1,680	12,840
1992-95		5760						
1996		1440						
1997-2000		5760						
2001		<u>1440</u>						
		38880						<u>114,600</u>

Debenturing these loan amounts over
 25 years at 10% interest would
 result in an initial annual payment
 (1975) of \$9,796 or \$14.24/capita.
 Therefore, Provincial assistance
 would be required for this cost
 less \$13.76 or \$0.48/capita.

Year	Population	Debenture	Annual Payment	Total Annual Payment	\$/Capita
1975	688	\$ 88,920	\$9,796	\$9,796	\$14.24
1981	772	22,750	2,506	12,302	15.94
1986	849			12,302	14.49
1991	934	59,000	6,500	18,802	20.13
1996	1028			18,802	18.29
2001	1130				

iii) The costs of an irrigation program, including an extension of the out-fall line to the new lagoon location, new lagoons, and irrigation land are summarized forthwith.

Year	Pipeline Costs	Lagoon Cost	Land Cost	Other Costs	Engineering & Contingencies	Irrigation Land Costs	Total Cost
----- 1975 Dollars -----							
1975	25,000	26,120	5,600	3,170	5,240	26,800	91,930
1981		9,790	2,000	1,180	1,950	5,200	20,120
1986						5,600	5,600
1991		8,160	1,600	980	1,600	4,000	16,340
1996						4,000	<u>4,000</u>
							137,990

The capital cost of this system excluding irrigation equipment and operating costs would be \$137,990.

3.5 Recommendation

The recommended alternative for sewage to treatment to be pursued by the Town of Crossfield is one year storage in lagoons. This type of system is the most economical from a capital and operating cost viewpoint.

The estimated capital cost of \$116,540 (in terms of 1975 dollars) can possibly be reduced depending on the distance to a new lagoon location and the land costs in the area at the time of acquisition.

In evaluating the usefulness of the existing lagoon, careful consideration was given to the proximity of this lagoon to the water reservoirs and whether it is desirable to have a sewage treatment lagoon this close to the water supply storage system.

(see Plate 3.6). It is therefore recommended the existing lagoon be abandoned and the new lagoon system be constructed on the south side of the railroad tracks. Consideration should be given to acquiring in the order of 40 acres of land initially so that sufficient land will be available for lagoon expansion and for a buffer zone around



- ① Existing Lagoon Site
- ② Existing Water Storage Site
- ③ New Lagoon Site

VILLAGE OF CROSSFIELD

POSSIBLE SITE FOR NEW LAGOON CONSTRUCTION
SCALE: 1" = 50,000'



the lagoons.

The initial annual debenture cost is estimated to be \$8,761. Provincial assistance will not be available at this expenditure (\$12.73/capita) and the only methods of reducing the cost to the Town would be if cost savings are available on construction of the treatment system and if C.M.H.C. funds are still available at the time financing is required. C.M.H.C. grants would reduce the total cost and therefore the annual payment by 1/6 to \$10.61/capita/year. Acquiring additional land over that required for initial lagoon construction could raise the initial debenture costs to over \$13.76/capita/year which would make Crossfield eligible for Provincial assistance.

Although no operation and maintenance costs were indicated by the Town for the present sewage lagoon system, operation and maintenance are required. Allowing \$2,500 per year initially for this service the total annual payment becomes about \$11,261. The revenue generated from sewer service charges in 1973 was \$9,356 which, when prorated for population increases to 1975, should generate enough

income to cover the annual payment. Following the concept of user pays, consideration should be given to raising the unit rates in the event that annual revenue generated from these rates does not cover annual expenditure for this service.

4. TOWN OF CARSTAIRS

4.1 Growth Trends

Present population (1971) and selected levels of population on which to base engineering plans.

Census Year	1951	1956	1961	1966	1971
Population	468	449	665	761	884

The average quinquennial population projection method seems most realistic for forecasting the growth trends of Carstairs. The corridor water supply line will not substantially change the potential of Carstairs for attracting industry. Therefore, a population growth rate of 2.5% per year, which closely approximates the quinquennial population projection, will be used in this report.

Year	1971	1976	1981	1986	1991	1996	2001
Population	884	994	1119	1259	1416	1593	1793

4.2 Photography and Contours

High level air photographs of Carstairs and surrounding area (Plate 4.1) were supplied to Underwood McLellan & Associates Limited by Midwest Surveys from their air photograph library. Contour maps of the area surrounding Carstairs (Plate 4.2) were reproduced from Geological Survey of Canada, Department of Energy, Mines and Resources, maps supplied through the Alberta Department of Lands and Forests.



TOWN OF CARSTAIRS

AIR PHOTOGRAPH
SCALE: 1" = 2640'





TOWN OF CARSTAIRS

EXISTING SEWAGE TREATMENT LAGOON SYSTEM
SCALE : 1" = 2640'

4.3 Sanitary Sewerage System

4.3.1 General Description

The Town of Carstairs is serviced by conventional means, that is, an underground system of collection mains employing gravity flow to an outfall line.

The outfall conveys all collected sewage to the sewage lagoon site (see Plate 4.3) All sewer mains are 8 inches in diameter with main trunk lines being 10 inches and 12 inches in diameter. The outfall is a 12 inch diameter line.

4.3.2 Existing Sewage Works

- i) Influent Sewer - This is a 12 inch diameter line up to the lagoons.

The line is at an average grade of 0.20% and has a nominal design capacity of 1.5 cfs (560 gpm).

- ii) Sewage Lagoons - The existing sewage treatment facilities consist

of two anaerobic lagoons followed by one aerobic and one holding lagoon. The aerobic lagoon was constructed in 1962 with a water depth of 5 feet and a capacity of approximately 5 million gallons. The anaerobic cells were added in 1971, and a 15 million gallon holding lagoon was constructed in 1973. The lagoon system at present based on a yearly water usage of 14.6 million gallons provides for approximately 16 month's storage capacity.

4.3.3 Outfall and Receiving Area

The discharge from the lagoons is to a drainage ditch which flows east and then northeast and eventually discharges into Sheep Coulee.

4.3.4 Works Operating Problems

No operating problems have been reported by the Town.

4.3.5 Works Operating and Maintenance Costs

The operating and maintenance costs on the sewage treatment system are approximately \$3,500 - \$4,000 per year.

This figure includes sewer flushing as well as lagoon dyke maintenance and lagoon drainage.

4.3.6 Debenture Information

All debentures for the lagoon system constructed in 1965 have been paid off. New debentures were issued in 1973 for lagoon expansion. The two debentures issued were for \$48,000 at 8½% for 20 years and for \$65,478 at 7½% for 25 years resulting in annual payments of \$4,980.21 and \$6,556 respectively for a total of \$11,536.21.

4.3.7 Service Charge By-Laws

The sewer service charges provided for by the Service Charge By-Law of the Town

of Carstairs are for a sum of \$2.50 per month for single family dwellings or \$2.50 per month per unit for multiple dwellings and apartments. The remainder of the service charges provided for under the By-Law are shown below. The revenue from sewer service charges in 1973 was \$10,252.24.

Sewer Service Charges

Single Family Residence	\$2.50 per month
Multiple dwellings - per unit	\$2.50 per month
Apartments per Unit	\$2.50 per month
Family Dwellings in Commercial	
Building - each	\$2.50 per month
Stores - per unit	\$2.50 per month
Offices - per month per unit	\$2.50 per month
Hotels	\$32.50 per month
Creameries	\$15.00 per month
Restaurants	\$7.50 per month
Garages and Service Stations	\$5.00 per month
Car Wash	\$5.00 per month
Coin Laundry	\$5.00 per month
Schools per room	\$5.00 per month

4.4 Sewage Treatment Requirements for Future Development

4.4.1 Department of the Environment Standards

The Department of the Environment Standards for sewage treatment and disposal as they apply to the Town of Carstairs require either one year storage in lagoons or, secondary treatment followed by seven months storage in lagoons, including required provision for capacity for sewage flows increasing due to population growth and/or higher water consumption.

4.4.2 Alternatives for Sewage Treatment and Disposal

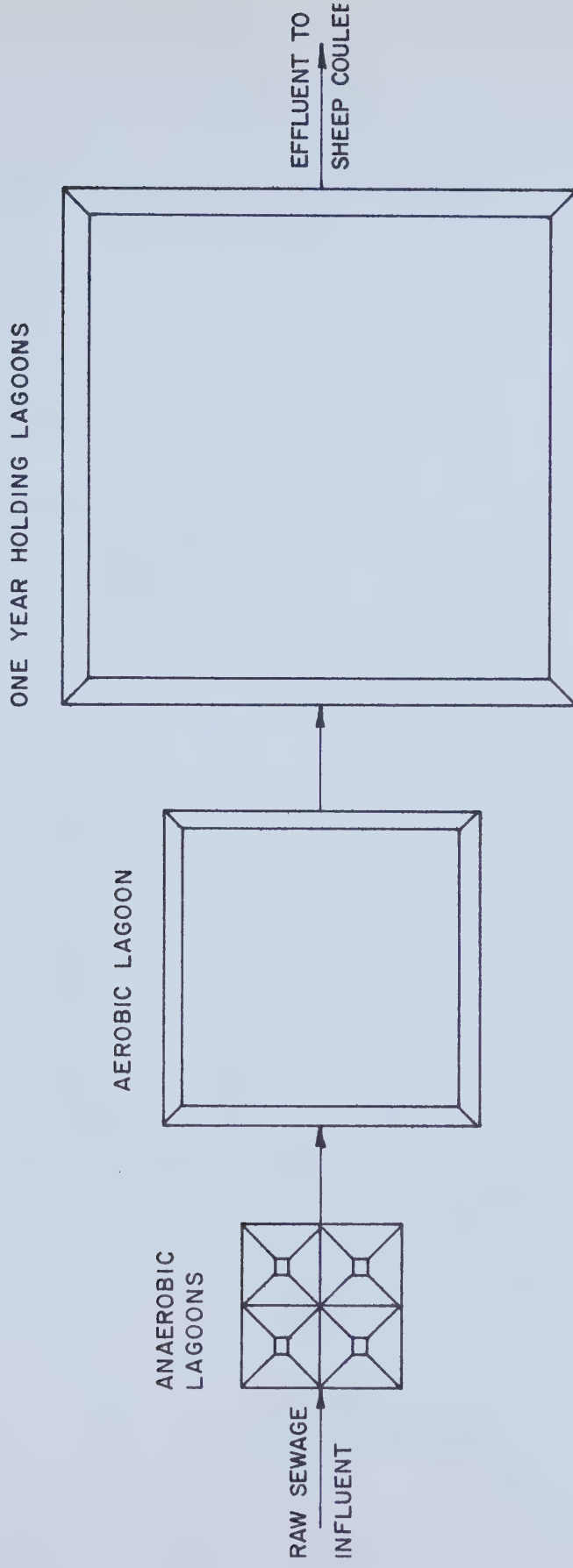
There are basically three alternatives for sewage treatment and disposal that would meet the Department of the Environment Standards. These are the one year storage in lagoons, secondary treatment plus seven months storage in lagoons, or 8 - 9 months storage in lagoons plus irrigation.

- i) The alternative of one year storage in lagoons (schematically illustrated in Plate 4.4) would require construction.

of new lagoons as population increases. Assuming the annual water consumption and therefore sewage flow to increase with time (1 gcd/year) and increasing population, the volumes of lagoons required at future dates as well as possible lagoon staging increments are indicated below. It should be noted that for future lagoon construction, a lift station may be required to enable the treated sewage to reach the drainage area.

Year	Population	Water Consumption GCD	Anaerobic Aerobic Treatment Lagoons MGAL	12 Month Storage MGAL	Total Lagoons MGAL	Lagoons Acres	Staged Construction MGAL	Acres
1975	994	60	3.8	21.8	25.6		11	9
1981	1119	65	4.7	26.5	31.2	17	7	6
1986	1259	70	5.6	32.2	37.8	23	8	6
1991	1416	75	6.7	38.8	45.5	29	5	4
1996	1593	75	7.5	43.6	51.1	33	7	6
2001	1792	75	8.4	49.1	57.5	39		

NOTE : Existing Capacity - 20×10^6 Gallons
 Required Capacity by 2000 - 58×10^6 Gallons
 Additional Land Required - 31 Acres



TOWN OF CARSTAIRS
 SCHEMATIC FLOW DIAGRAM
 OF
 ONE YEAR STORAGE ALTERNATIVE

ii) The second alternative, that of secondary treatment plus seven months storage can be met by a number of options for a secondary system, any of which must be followed by storage lagoons. The storage lagoon requirements for seven months storage assuming 10 foot water depth and 3/1 slope sidewall construction would be as follows:

Year	Population	Water Consumption GCD	7 Months Storage MGAL	New Lagoon Volume MGAL	New Lagoon Area Acres
1971	884	45	8.4		
1975	994	60	12.5		
1981	1119	60	14.1		
1986	1259	60	15.9	6	5
1991	1416	75	22.3		
1996	1593	75	25.1		
2001	1791	75	28.2		

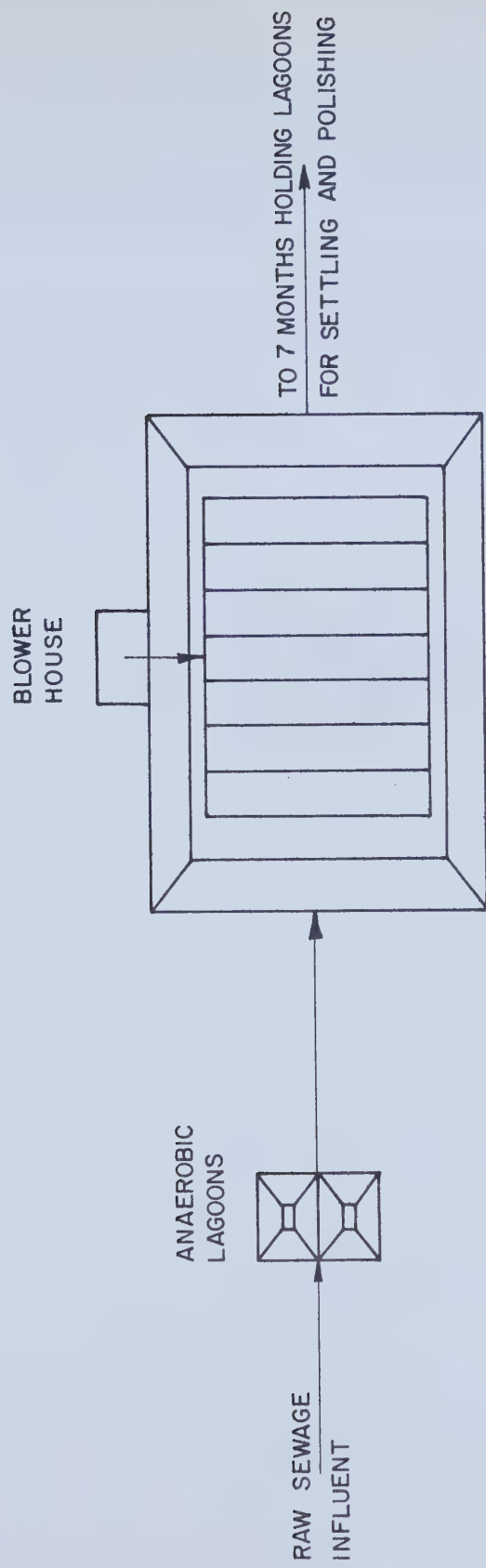
The present lagoon system would be adequate for about 15 years when preceded by secondary treatment. The alternatives for secondary

treatment then are activated sludge (conventional or package plant), extended aeration, or an aerated lagoon. Only the the aerated lagoon system (illustrated in Plate 4.5), will be detailed in this report as this is the most economical system and offers the least operating problems and operating costs for a community of this size.

The organic and hydraulic load to such a system is calculated based on an assumed BOD₅ load of 0.17 pounds BOD₅/day per capita, and the oxygen supply requirements are calculated from this load based on 1.5 pounds O₂ required per pound BOD₅

Year	Daily Flow MGD	BOD ₅ Load Lbs/day	O ₂ Required Lbs/day	Lbs/hr.
1975	.060	169	254	11
1981	.067	190	285	12
1986	.076	214	321	13
1991	.106	241	362	15
1996	.120	271	407	17
2001	.134	305	458	19

NOTE: Volume - 1.5×10^6 Gallons
Approximate Dimensions
220' x 300' at 10' Depth



TOWN OF CARSTAIRS
SCHEMATIC FLOW DIAGRAM
OF
AERATED LAGOON ALTERNATIVE

An aerated lagoon of about 1.5 million gallon capacity would be sufficient for the Town of Carstairs and it would afford 25 days retention time initially, decreasing to 11 days by the end of the century. The existing aerobic lagoon could be modified to serve as an aerated lagoon. This would involve some excavation of the lagoon bottom to allow a greater operating depth, and construction of a dividing wall so that only a portion of the 5 million gallon lagoon would be aerated or, a new 1.5 million gallon lagoon could be installed instead of modifying the existing lagoon. Consideration should be given to either using the existing anaerobic lagoons or constructing new ones preceding the aerated lagoon to remove grit and reduce the solids loading to the aerated lagoon. There are little

economics in staging aeration equipment installation as the governing criteria is oxygen dispersion and solids circulation and not oxygen supply. The air supply system would consist of three 10 hp compressors (one on standby).

- iii) The third alternative, that of 8 - 9 months storage plus anaerobic - aerobic ponds preceding irrigation, would require the following minimum lagoon capacities and land areas (8 months storage preceded by 4 anaerobics of 2 - 4 days retention each plus an aerobic pond of about 2 months retention) for treatment and storage, and the following land areas for irrigation (assuming an application rate of 12 inches per year).

Year	Population	Water Consumption GCD	Flow MGD	Treat- ment plus Storage MGAL	Staged MGAL	Lagoon Acres	Irrigation Land Acres
1975	994	60	.060	18.2	8	6	98
1981	1119	65	.073	22.1			20
1986	1259	70	.088	26.7	5	4	24
1991	1416	75	.106	32.2	5	4	18
1996	1593	75	.119	36.1	4	4	20
2001	1792	75	.134	40.6			

4.4.3 Costs for Alternative Sewage Treatment and Disposal Schemes

i) The cost of staged 12 months storage in lagoons preceded by an anaerobic - aerobic pond system is estimated to total \$94,140 in 1975 dollars.

Year	Lagoon Size	Lagoon Costs	Land Costs	Other Costs	Engineering & Contingencies	Total Costs
----- 1975 Dollars -----						
1975	11	17,950	3,600	2,150	3,550	27,250
1981	7	11,430	2,400	1,380	2,280	17,490
1986	8	13,060	2,400	1,550	2,550	19,560
1991	5	8,160	1,600	980	1,610	12,350
1996	7	11,430	2,400	1,380	2,280	<u>17,490</u>
						<u>\$94,140</u>

Debenturing these loan amounts at
 10% interest over 25 year terms
 yield annual debenture payments of
 \$15.40/capita in 1975

Year	Population	Total Cost	Debenture Payment	Total Annual Payment	\$/Capita	Existing \$	Debentures \$/Capita	Total \$/ Capita
1975	944	\$ 27,250	\$ 3,002	\$ 3,002	\$ 3.18	\$ 11,536	\$ 12.22	\$ 15.40
1981	1119	30,985	3,413	6,415	5.73	11,536	10.31	16.04
1986	1259	55,790	6,146	12,561	9.98	11,536	9.16	19.14
1991	1416	56,740	6,251	18,812	13.29	11,536	8.15	21.44
1996	1593	129,420	14,258	33,070	20.76	6,556	4.12	24.88

ii) The cost of a secondary treatment
 system preceded by seven months
 storage in lagoons is estimated to have
 a capital cost of \$45,000 plus an
 operating cost up to the year 2000
 of \$38,880 for a total of \$83,880.

Year	Secondary Treatment Costs	Operating Costs	Lagoon Costs	Land Costs	Other Costs	Engineering & Contingencies	Total Cost
----- 1975 Dollars -----							
1975	30,000	1,440					30,000
1976- 1980		7,200					
1981		1,440					
1982- 1985		5,760					
1986		1,440	9,800	2,000	1,200	2,000	15,000
1987- 1990		5,760					
1991		1,440					
1992- 1995		5,760					
1996		1,440					
1997- 2000		5,760					
2001		1,440					
							45,000

If we assume that the capital expenditures are debentures at 10% per annum for 25 year terms, the initial annual payments become equal to \$15.72/capita.

Year	Debenture Amount	Debenture Payment	Total Annual Debenture	\$/Capita	Existing \$	Debtures \$/Capita	Total \$/Capita
1975	\$30,000	\$3,305	\$3,305	\$3.50	\$11,536	\$12.22	\$15.72
1981			3,305	2.95	11,536	10.31	13.26
1986	42,800	4,715	8,020	6.37	11,536	9.16	15.53
1991			8,020	5.66	11,536	8.15	13.81
1996			8,020	5.03	6,556	4.12	9.15
2001							

iii) The cost of eight months storage followed by irrigation are those costs associated with constructing a lagoon and irrigation system to provide eight months (plus anaerobic - aerobic ponds) storage with allowance for expanding flows due to population increases and per capita water consumption increases.

The cost of the lagoon system is estimated to be \$54,510 and the cost of the irrigation land would be \$72,000 for a total of \$126,510, not including irrigation equipment and operating costs which are estimated to approximate \$180/acre.

Year	Lagoon Size	Lagoon Cost	Land Cost	Other Costs	Engineering and Contin- gencies	Total Cost	Irrigation Land Acres	Land Costs
					1975 Dollars			
1975	8	13,060	2,400	1,540	2,550	19,550	98	39,200
1981							20	8,000
1986	5	8,160	1,600	970	1,610	12,340	24	9,600
1991	5	8,160	1,600	970	1,610	12,340	18	7,200
1996	4	6,530	1,600	810	1,340	<u>10,280</u>	20	<u>8,000</u>
						54,510		72,000

4.5 Recommendation

The most practical and most economical system for the treatment of wastewaters from the Town of Carstairs is one year storage in lagoons. This system requires the least operation and maintenance attention and, can be easily integrated with the existing lagoon system (possible lagoon site- Plate 4.6). A lift station may be required to enable treated sewage to reach the drainage course.

The total cost (in 1975 dollars) of the recommended lagoon system is \$94,140. This capital expenditure could be reduced if C.M.H.C. funds are still available at the time of construction, and can be spread out by staging construction of the lagoons. Approximately one-half of the total expenditure would be required initially to upgrade the existing system, resulting in debenture payments, (based on 25 year term at 10% interest) of approximately \$3,002/year, which when combined with existing debenture payments of \$11,536/year would amount to \$14,538/year or \$15.40/capita/year for sewage treatment. The need for a lift station



- Existing Site
- New Site

TOWN OF CARSTAIRS

POSSIBLE SITE FOR LAGOON EXPANSION
 SCALE: 1" = 50,000"



would add approximately \$40,000 to the above costs. Since Provincial assistance for sewage treatment is available after the first \$13.76/capita/year, the Town of Carstairs would be eligible for Provincial assistance of \$1.64/capita/year at the outset.

Total annual expenditure by the Town of Carstairs would be \$16,489 (plus \$1,549 Provincial assistance) which includes \$3,500/year for maintenance. The revenue generated in 1973 from sewer service charges was \$10,252 which when prorated for population growth would not be adequate to cover the annual expenditures for sewage treatment and disposal and therefore consideration should be given to increasing sewer service rates.

5. TOWN OF DIDSBURY

5.1 Growth Trends

Present Population (1971) and selected levels of population on which to base engineering plans.

Census Year	1951	1956	1961	1966	1971
Population	1180	1227	1254	1586	1821

The Town of Didsbury is centrally located between Calgary and Red Deer in an excellent farming area. It has enjoyed relatively consistent growth over the past twenty years and, with a non-limiting water supply should continue to exhibit a continuing constant (strong) growth rate. Therefore, a growth rate of 5.3%, as indicated by the maximum quinquennial growth rate which occurred in the 1961 - 1966 period (i.e. 332 persons or 26.5%), has been chosen to represent the predicted growth of Didsbury. It is not presently anticipated that major wet industries would locate in Didsbury although it certainly is a possibility. It is, however,

considered that Didsbury will sustain some degree of industrial growth.

Year	1971	1976	1981	1986	1991	1996	2001
Population	1821	2304	2914	3686	4663	5899	7462

5.2 Photography and Contours

High level air photography prints of Didsbury and surrounding area (Plate 5.1) were reproduced from air photographs supplied to Underwood McLellan & Associates by the Department of Highways from the Alberta Department of Lands and Forests, Aerial Surveys Section. Contour maps of the area surrounding Didsbury (Plate 5.2) were reproduced from Geological Survey of Canada, Department of Energy, Mines and Resources, maps supplied through the Alberta Department of Lands and Forests.

5.3 Sanitary Sewerage System

5.3.1 General Description

The Town of Didsbury is serviced by conventional means, that is, an underground system of collection mains employing gravity flow to an outfall line. For the northwest portion of Didsbury a sewage lift station pumps the collected sewage to an elevation such that it can flow by gravity to the sewage disposal plant along with the remainder of the Town's sewage. The outfall line conveys all sewage to the sewage lagoon site as shown in Plate 5.3. All collection mains are 8 inches and 10 inches in diameter and the outfall is a 12 inch diameter line.

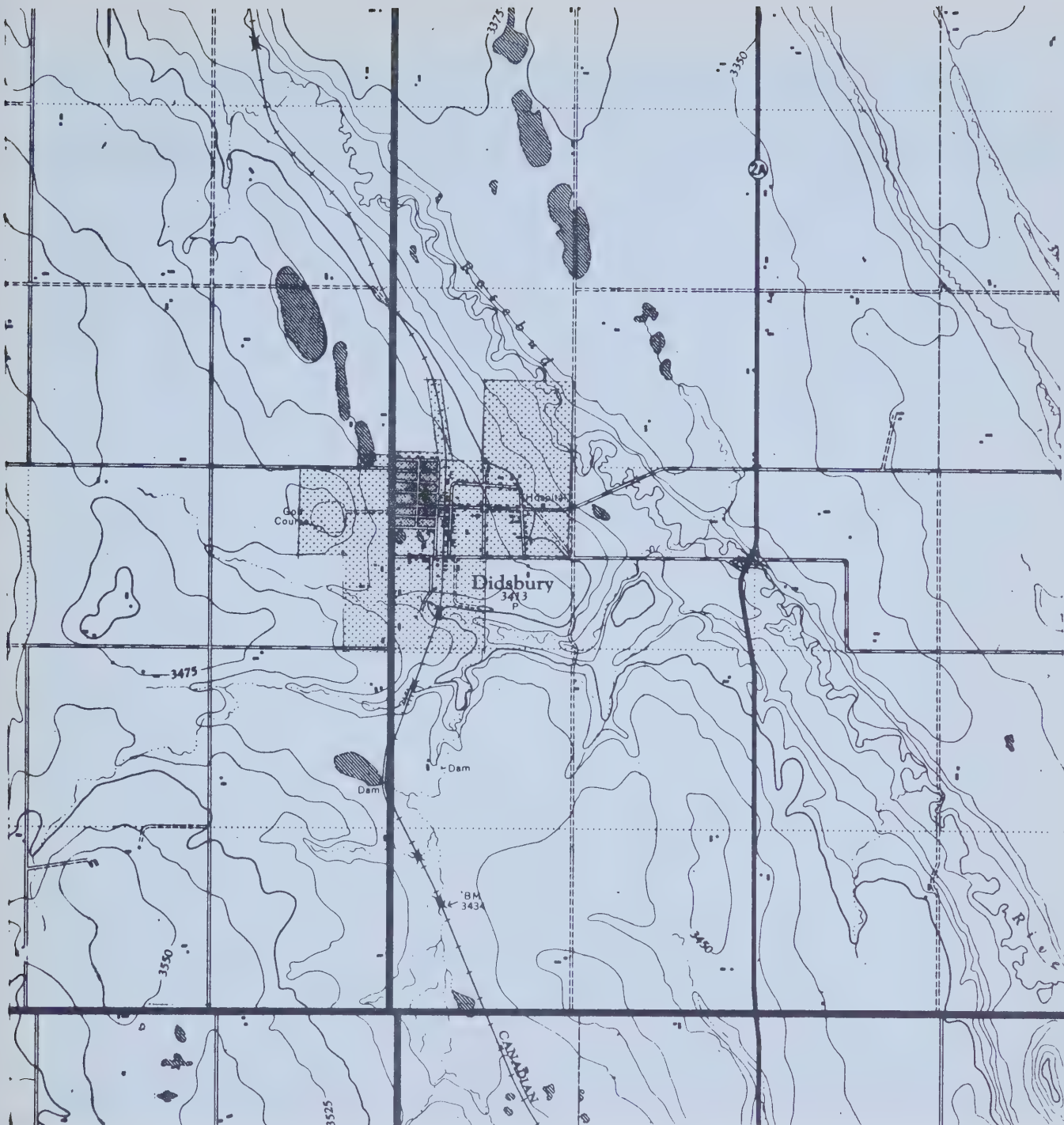
5.3.2 Existing Sewage Work

- i) Influent Sewer - This is a 12 inch diameter line up to the lagoons. The line is at an average grade of 0.22% in town, approximately 5% down the



TOWN OF DIDSBURY

AIR PHOTOGRAPH
SCALE: 1" = 2640'



TOWN OF DIDSBURY

CONTOUR MAP
SCALE: 1" = 50,000 "





TOWN OF DIDSBURY

EXISTING SEWAGE TREATMENT LAGOON SYSTEM

SCALE: 1" = 2640'

hill, and 0.30% the last 900 feet to the lagoons and has a nominal design capacity of about 1.50 cfs (560 gpm).

ii) Lift Station - The lift station at Hammond St. and Shantz St. lifts the sewage collected from the northwest section of town an elevation of about 4 feet to enable it to gravity flow along with the rest of the town's sewage to the lagoon site.

iii) Sewage Lagoons - The existing sewage treatment facilities consist of 4 anaerobic lagoons and 2 aerobic lagoons and were completed in 1969. The anaerobic cells are about 9' deep and about 250,000 gallons each in capacity. Aerobic cell number 1 has a depth of about 4 feet and a capacity of about 6 million gallons, while aerobic cell number 2 has a depth of about 6 feet and a capacity

of about 14 million gallons.

Therefore, the total capacity of the system is approximately 21 million gallons and at 52 gcd for the 1973 population of 1911, provides 7 months storage (210 days).

5.3.3 Outfall and Receiving Area

The outfall is a 12 inch diameter line running from aerobic cell number 2 a distance of 1884 feet at an average grade of 0.26% to the Rosebud River. The outfall line discharges to the Rosebud River just before the river crosses under Highway 2A.

The average mean discharges for Rosebud River in this area were taken from the Alberta Historical Streamflow Summary as published by the Inland Waters Directorate, Department of the Environment and for the period 1957 - 1970 and the months of March to October are as follows:

Month	March	April	May	June	July	Aug.	Sept.	Oct.
Mean (cfs)	56.6	66.5	11.6	9.6	9.4	1.6	1.7	1.3

Therefore on a mean discharge basis the dilutions offered by Rosebud River at the present flow of 52 gpd and population 1911 (or 0.18 cfs) are as follows:

Month	March	April	May	June	July	Aug.	Sept.	Oct.
Dilution	314/1	369/1	64/1	53/1	52/1	9/1	9.5/1	7/1

5.3.4 Works Operating Problems

There are no real operating problems of the Town of Didsbury sewage lagoon facility other than capacity. Expansion of the facilities will be required as population, industrial development, and per capita water consumption increase.

5.3.5 Works Operating and Maintenance Costs

The annual sewage works operating and maintenance costs are in the order of \$3,600 to \$4,000.

5.3.6 Debenture Information

The outstanding debentures for the Didsbury sewage treatment system all relate to construction and expansion of the existing sewage lagoon system. The debentures were issued in 1967, 1968, and 1969 and have 25 year terms. The loans were at 5-3/4%, 6-3/4% and 8% respectively with annual payments of \$2,375.86, \$1,673.35, and \$2,416.54 respectively for a total annual payment of \$6,465.75.

5.3.7 Service Charge By-Laws

The sewer service charges provided for by the Service Charge By-Law of the Town of Didsbury are shown below. The basic rates are \$5.00 for two months or \$2.50 per month for individual dwellings and per unit for apartment blocks and stores and offices. The total revenue generated from these charges in 1973 was \$21,000.

Sewer Service Charges

Basis of two months

Dwellings	\$5.00
Apartments per Unit	5.00
Stores & Offices per Unit	5.00
Hotels	110.00
Restaurants	16.50
Garages and Service Stations	9.00
Schools	55.00
Laundromats	13.20
Drycleaners	9.00
Car Wash	17.60
Hospitals	110.00
Feed Mills	9.00
Cement Mixing	9.00
Trailer Courts	1.00 per trailer per month
Motels per Unit	2.00
Drive Ins	8.00

5.4 Sewage Treatment Requirements for Future Development

5.4.1 Department of the Environment Standards.

The Department of the Environment Standards for sewage treatment and disposal as applied to the Town of Didsbury call for seven months storage in lagoons or secondary treatment. Provision must be made for population growth and industrial development.

5.4.2 Alternatives for Sewage Treatment and Disposal

The alternatives available to the Town of Didsbury for treatment and disposal of sewage are seven months storage or secondary treatment. The option of irrigation is not economically applicable here as seven months storage is still required before irrigation due to the limited irrigation season. The additional cost of pumping and irrigation equipment could not be justified under the present Environment Standards.

The domestic water consumption rate will be assumed to increase from 60 gcd in 1975 to 75 gcd in 1991 (at a rate of about 1 gcd/year) while an industrial water consumption and therefore wastewater will be assumed to contribute 10 gcd until 1986 and 15 gcd thereafter.

- i) Seven months storage for sewage from the Town of Didsbury is the present method of sewage treatment before discharge to the Rosebud River. To continue with this disposal method, allowance must be made for increasing sewage flows due to population growth and industrial expansion resulting from a corridor water supply system as well as an increasing per capita water usage resulting from this corridor supply system. In addition, provision for anaerobic followed by aerobic ponds, must be continued to provide about 2 (plus) months of treatment

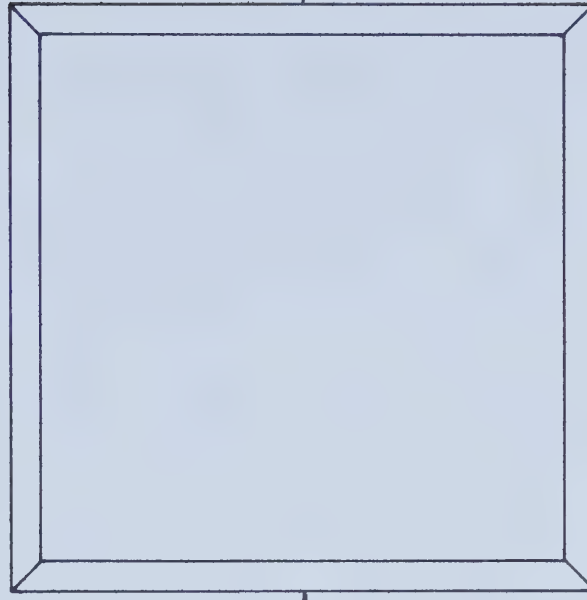
before holding (see Plate 5.4).

The capacity of the present system is about 21 million gallons. To meet the capacities required by an expanding population and water usage, additional storage capabilities in the order of 165 million gallons will be required by the end of the century. The most economical method of expanding a lagoon system is by staging. For the purposes of this study it will be assumed that the lagoon system will have staging intervals of about 5 years. Therefore the stage added in a particular year will increase the capacity of the system to allow seven months storage for the flow 5 years in the future.

The additional acreage requirement for a staged lagoon system with sufficient capacity for seven months storage for the sewage from the Town of Didsbury until the end of the century is estimated to be 103 acres (based on 10 foot average

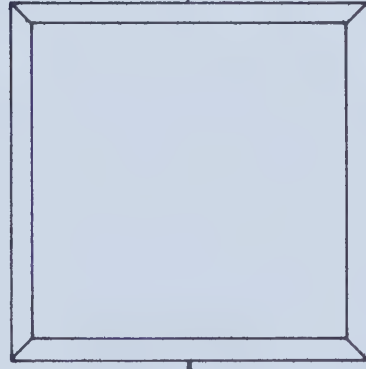
NOTE: Existing Capacity - 58 x 10⁶ Gallons
 Required Capacity by 2000 - 58 x 10⁶ Gallons
 Additional Land Required - 31 Acres

ONE YEAR HOLDING LAGOONS

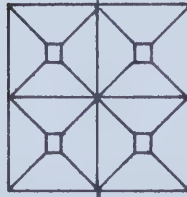


EFFLUENT TO
SHEEP COULEE

AEROBIC LAGOON



ANAEROBIC
LAGOONS



RAW SEWAGE
INFLUENT

TOWN OF CARSTAIRS

SCHEMATIC FLOW DIAGRAM
OF
ONE YEAR STORAGE ALTERNATIVE

water depth, 3 feet freeboard, and
3/1 slope on the lagoon walls.

Year	Population	Water Consump- tion GCD	Anaero- bic Plus Aerobic Treatment Ponds MGAL	7 Months Domestic MGAL	Storage Industry MGAL	Total MGAL	Staged MGAL	Additi Acre
1975	2188	60+10	11.1	29.0	4.8	45	40	26
1981	2914	65+10	14.9	39.8	6.2	61	23	15
1986	3686	70+10	21.9	54.2	7.8	84	35	21
1991	4663	75+15	30.6	73.4	14.7	119	31	19
1996	5899	75+15	37.3	92.9	18.6	149	37	22
2001	7462	75+15	45.7	117.5	23.5	187		

ii) The option of secondary treatment for the sewage from the Town of Didsbury can be provided by a number of alternative systems. However, due to the existence of a lagoon system, the most economical method of secondary treatment would be to modify the existing system to an aerated lagoon system. This can be accomplished by the addition of mechanical aeration

equipment and modification of the lagoon walls to allow a greater liquid depth. Assuming an organic load to the treatment system of 0.17 pounds BOD₅ per population equivalent (based initially on 60 gcd increasing by 1 gcd/year to 75 gcd after 1991) the mechanical aeration oxygen supply requirements can be estimated (use 1.5 pound O₂ per pound BOD₅):

Year	Daily Flow MGD	Population Equivalent	BOD ₅ Load lbs/day	O ₂ Requirement lbs./day	lbs./hr.
1975	0.153	2553	434	651	27
1981	0.218	3362	571	857	36
1986	0.294	4212	716	1074	45
1991	0.420	5596	951	1427	59
1996	0.531	7079	1203	1805	75
2001	0.672	8954	1522	2283	95

The first aerobic cell would require modification to allow a greater water

depth. This can be accomplished by building up the lagoon walls. In addition a separating wall to divide the pond in half would be required giving each half of the ponds about 4.5 million gallons capacity at a 8 foot water depth. Initially, the first half of this pond would act as the aeration lagoon with mechanical aeration equipment installed in it. The second half of this lagoon would act as the settling and polishing portion, and the second lagoon would act as the final polishing portion. As flows increase, the first portion of the lagoon will afford less and less detention time and so at some time, probably about 1991, mechanical aeration equipment will be required in the second portion of the lagoon. The treatment operation would then be that of a two-stage aerated lagoon followed by a settling

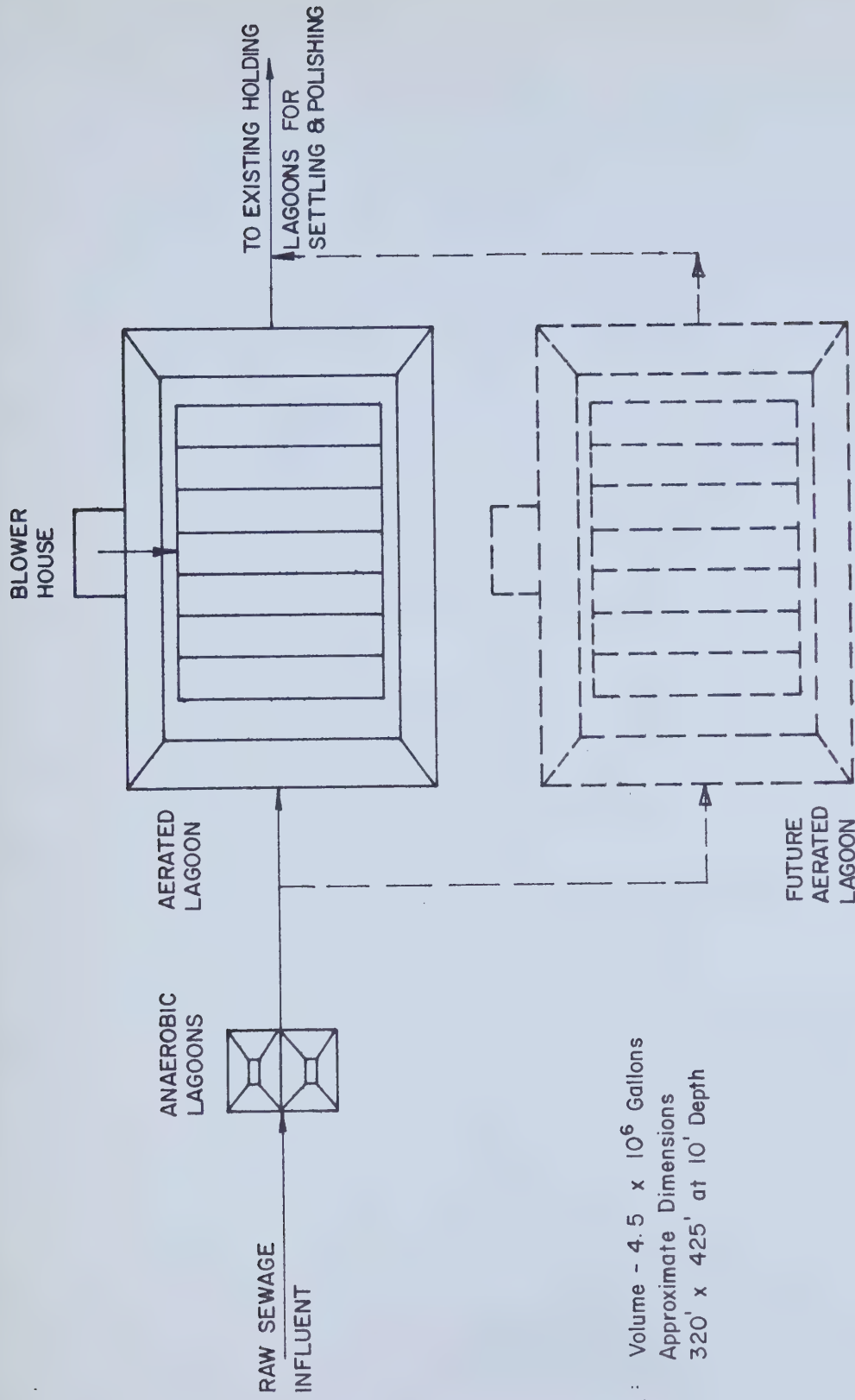
and polishing lagoon. Alternatively, a new aeration cell could be constructed to treat the wastewater up to about 1991 when a second cell could be constructed (see Plate 5.5).

Consideration of installing anaerobic ponds before the aerated lagoon should be given to reduce the grit and organic load to the aerated lagoon.

The governing criteria for aeration horsepower in this case is oxygen dispersion and solids circulation rather than oxygen supply, and it is therefore estimated that about 60 horsepower of aeration equipment would be required in each phase of the treatment plant. This could be satisfied by 3 x 30 horsepower compressors (one on standby) or 4 x 20 horsepower compressors (one on standby).

5.4.3 Costs of Alternative Sewage Treatment and Disposal Schemes

- i) The costs of expanding a lagoon system



NOTE : Volume - 4.5 x 10⁶ Gallons
 Approximate Dimensions
 320' x 425' at 10' Depth

TOWN OF DIDSBURY
 SCHEMATIC FLOW DIAGRAM
 OF
 AERATED LAGOON ALTERNATIVE

to supply 7 months storage for wastewater flows for the rest of the century are estimated to be \$410,730 in terms of 1975 dollars assuming a 1975 land cost of \$500/acre.

Year	Lagoon Size MGAL	Lagoon Costs	Land Costs	Other Costs	Engineering & Contingencies	Total Cost
----- 1975 Dollars -----						
1975	40	65,300	13,000	7,830	12,920	99,050
1981	23	37,540	7,500	4,510	7,435	56,985
1986	35	57,130	11,500	6,860	11,375	86,815
1991	31	50,600	9,500	6,040	9,965	76,405
1996	37	60,390	12,000	7,240	11,945	<u>91,475</u>
						410,730

To debenture these loan amounts at 10% rate of interest and 25 year terms an initial annual payment of \$10,912 will be required. When the existing debenture debt for sewage treatment is considered, the annual payment becomes \$7.95/capita.

Year	Population	Total Cost	Annual Payment	Total Annual Payment	\$/Capita	Existing Sewage Debentures Annual \$	\$/ Capita	Total \$/ Capita
1975	2,188	\$99,050	\$10,912	\$10,912	\$4.99	\$6,466	\$2.96	\$7.95
1981	2,914	100,951	11,122	22,034	7.56	6,466	2.22	9.78
1986	3,686	247,699	27,289	49,323	13.38	6,466	1.75	15.13
1991	4,663	351,084	38,678	88,001	18.87	6,466	1.39	20.26
1996	5,899	677,672	74,651	162,652	27.57			
2001	7,462			151,740				

ii) The costs of a secondary treatment system for the Town of Didsbury would be those costs associated with modifying the walls of the existing lagoon or building a new aeration lagoon and anaerobic ponds, and the installation and operation of mechanical aeration equipment. Building up the lagoon walls and dividing the lagoon should be done at once, but the installation of aeration equipment can be staged.

The estimated cost of modifying the

lagoon walls or building a new lagoon in 1975 is \$10,000.

The staged installation of aeration equipment would require an initial (1975) installation of a compressor building (i.e. concrete slab and metal building) and compressors as well as the subsurface aeration equipment. The remaining subsurface aeration equipment and compressors would be required around 1991.

Year	Secondary Treatment Costs	Operating Costs	Engineering & Contingencies	Total
----- 1975 Dollars -----				
1975	50,000	4,320	7,500	57,500
1981		4,320		
1986		4,320		
1991	50,000	8,640	7,500	57,500
1996		8,640		

				115,000

The total cost of the secondary treatment system is estimated to be \$115,000 and the operating costs from 1975 to 2001 are estimated to be \$155,500 for a total of \$270,500.

Debenturing these costs over 25 years 10% interest yields initial annual payments of \$2.90 per capita which when combined with the existing debenture debt of \$2.96/capita results in a total annual payment of \$5.86/capita, which is well below the Provincial Assistance level.

Year	Population	Total Cost	Debenture Cost	Total Annual Payment	\$/Capita	Existing Debenture Annual \$/Capita	Total \$/Capita
1975	2,188	\$57,500	\$6,335	\$6,335	\$2.90	\$6,466	\$5.86
1981	2,914			6,335	2.17	6,466	4.39
1986	3,686			6,335	1.72	6,466	3.47
1991	4,663	364,210	29,108	35,443	7.60	6,466	8.99
1996	5,899			35,443	6.01		6.01

5.5 Recommendation

The alternatives of secondary treatment or seven months storage in lagoons for treatment of sewage from the Town of Didsbury both have their advantages and disadvantages.

The aerated lagoon system reduces the land area requirement for treatment and has a lower capital cost, but involves a higher operating cost, a higher maintenance cost (blowers and related equipment), and a possible sludge buildup and disposal problem.

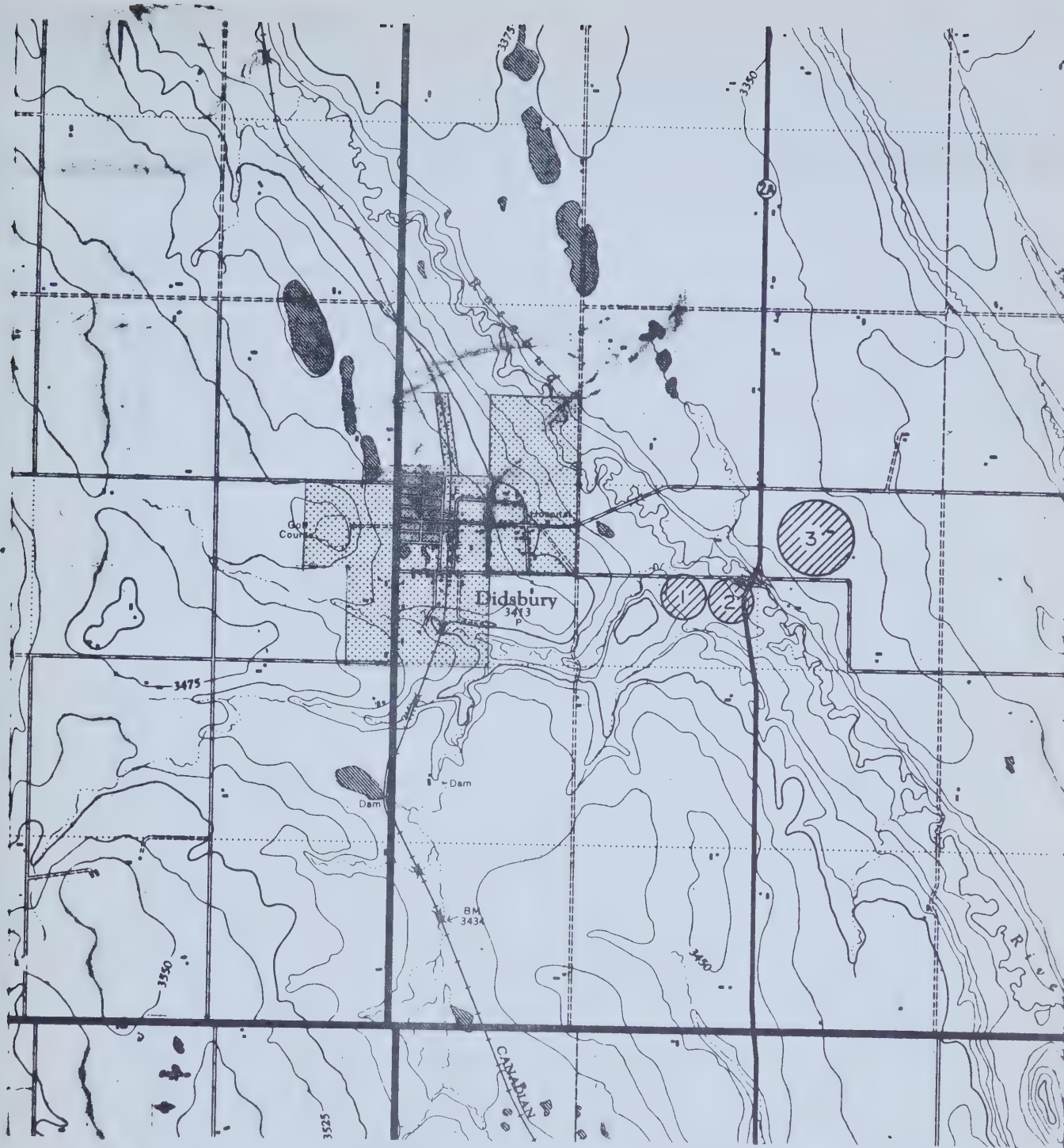
The seven months storage system alternative has an increasing land requirement and a higher capital cost, but is easier and less expensive to operate and maintain, and in the event that irrigation becomes feasible at a later date due to more stringent treatment regulations, it is quite easily adaptable to irrigation. The anaerobic-aerobic pond system preceding the seven months storage is more susceptible to spring turnover causing unpleasant odour for a short period of time.

The estimated capital expenditures are not sufficient such that Provincial assistance would

be available for either system. The initial estimated annual expenditures which must be generated by the Town to pay for each system are:

	<u>Aerobic Lagoon</u>	<u>Seven Month Storage</u>
Debenture	12,801	17,378
Operating	4,320	4,000
Maintenance	<u>6,000</u>	<u> </u>
	\$23,121	\$21,378

The revenue generated in 1973 by sewer service charges was \$21,000 which when prorated for population growth would generate sufficient revenue to cover the annual payments for sewage treatment. Therefore, the decision on which system to employ would depend on present and future land availability, cost of land, and desirability of a mechanical system versus a lagoon system. Plate 5.6 illustrates the immediate and future land area available for expansion. Once the present site has reached its lagoon capacity it will be necessary to lift the sewage to be treated or held to the east side of Highway No. 2A. about one-half mile from the existing lagoons.



- ① - Existing Site
- ② - New Site
- ③ - Future Site

TOWN OF DIDSBURY

POSSIBLE SITES FOR LAGOON EXPANSION
SCALE: 1" = 50,000'



Therefore, it is recommended that the seven months storage system be expanded to handle future sewage flows until such time as further lagoon expansion is limited by land availability. At that time an aerated lagoon should be constructed at the front end of the storage system, with the storage system then acting as the settling and polishing portion of the treatment scheme before discharge to the Rosebud River.

6. TOWN OF OLDS

6.1 Growth Trends

Present Population (1971) and selected levels
of population on which to base engineering plans.

Census Year	1951	1956	1961	1966	1971
Population	1617	1980	2433	2999	3376

The Town of Olds is centrally located between Calgary and Red Deer and is a designated agricultural growth centre. The growth of Olds has been quite consistent over the past 20 years, and with a corridor water supply line and with industry locating in Olds (such as the proposed meat packing plant) the growth of Olds should continue to be so.

Therefore, for the purposes of this study a growth rate of 4.65% per year as derived from the maximum quinquennial population projection method has been used to forecast future population growth as set out in the following Table:

Year	1971	1976	1981	1986	1991	1996	2001
Population	3376	4161	5129	6322	7793	9605	11,838

6.2 Photography and Contours

High level air photographs of Olds and surrounding area (Plate 6.1) were supplied to Underwood McLellan & Associates Limited by the Department of Highways from air photos taken by the Alberta Department of Lands and Forests, Aerial Surveys Section. Contour maps of the area surrounding Olds (Plate 6.2) were reproduced from Geological Survey of Canada, Department of Energy, Mines and Resources, maps supplied through the Alberta Department of Lands and Forests.

6.3 Sanitary Sewerage System

6.3.1 General Description

The Town of Olds is serviced by an underground system of collection mains employing gravity flow to an outfall line plus a number of lift stations to raise the collected sewage at low lying points to an elevation suitable for gravity flow to the outfall line. The outfall conveys all collected sewage to the sewage treatment plant site as shown in Plate 6.3. Collection mains are 8, 10 and 12 inches in diameter and the outfall is a 15 inch diameter line.

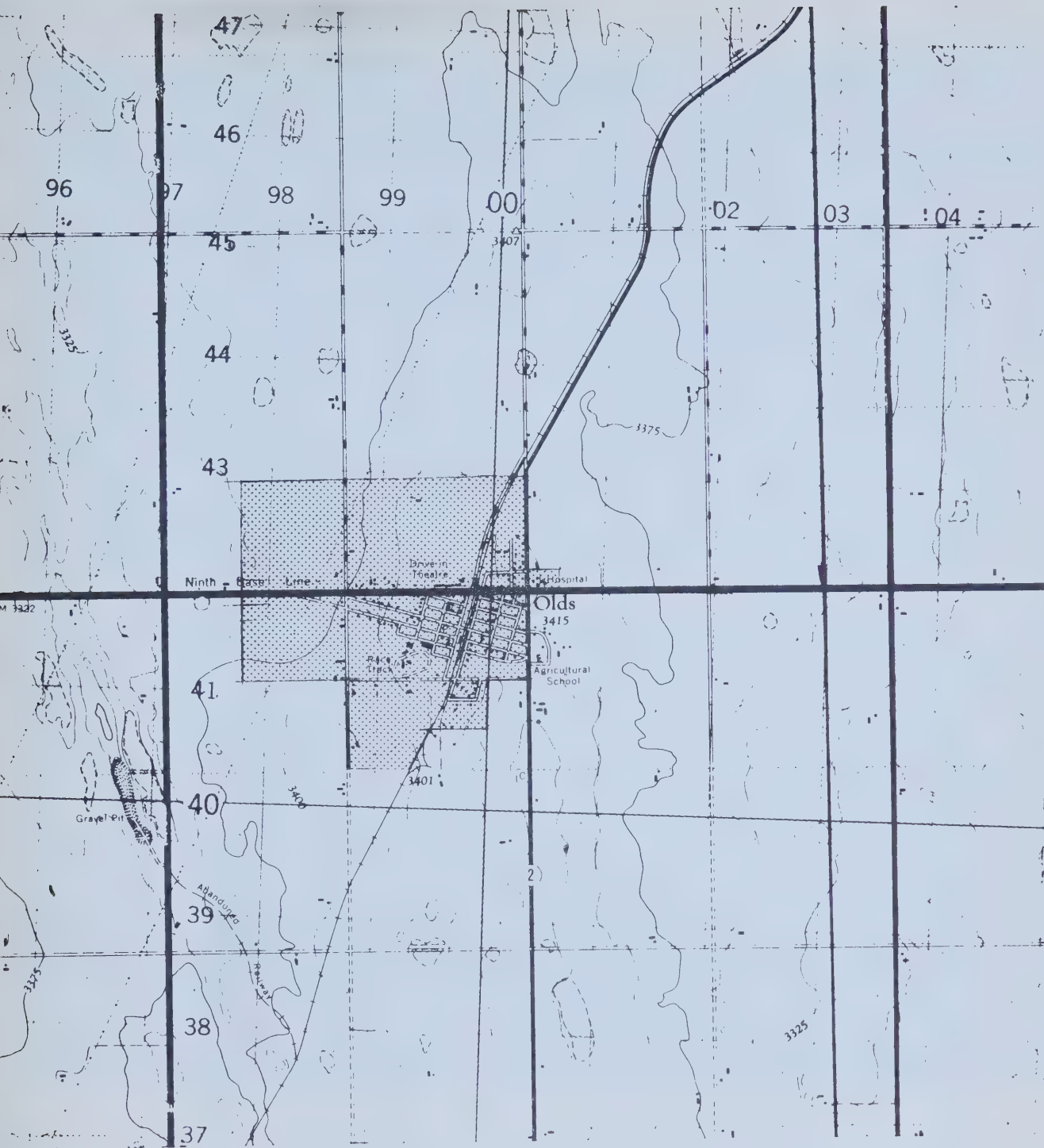
6.3.2 Existing Sewerage Works

- i) Influent Sewer - The influent sewer or sewerage collection outfall line is 15 inches in diameter with an estimated capacity of 2.4 cfs (910 gpm).
- ii) Lift Station - A number of lift stations are located in Olds to pump collected



TOWN OF OLDS

AIR PHOTOGRAPH
SCALE: 1" = 2640'



TOWN OF OLDS

CONTOUR MAP
SCALE: 1" = 50,000"





TOWN OF OLDS

EXISTING SEWAGE TREATMENT OXIDATION DITCH SYSTEM
SCALE: 1" = 2640'

sewage from low lying areas to tie-in points at higher elevations from where it can gravity flow along with the rest of the sewage to the sewage treatment facilities. A major lift station is located at Olds Agricultural College.

- iii) Oxidation Ditch - The existing sewage treatment facilities consist of an oxidation ditch, a clarifier, and a chlorine contact tank (an Imhoff tank from the previous treatment system). The ditch was constructed in 1966 with 2 rotors for circulation and air supply. In 1971 a third rotor was added, the ends of the ditch were lined with hypalon, and chlorination and flow metering facilities were installed. The oxidation ditch has a volume of 256,000 Imperial gallons when operated at 4 feet of liquid depth, and a volume of 356,000 Imperial gallons when operated at 5 feet of liquid depth. Normal operation at present is between 4 and 4.5 feet

of liquid depth. The clarifier which receives the discharge from the oxidation ditch, has a volume of 54,000 Imperial gallons, with a surface area of 690 square feet. The settled biological solids are pumped from the clarifier and returned to the oxidation ditch or wasted (to landfill) as required. The clarifier overflow is chlorinated and the Imhoff tank is used as the chlorine contact chamber. The biologically treated, settled, and chlorinated effluent is discharged from the Imhoff tank to the plant outfall line about 100 feet to Olds Creek.

6.3.3 Outfall and Receiving Area

The effluent from the treatment plant is discharged into a drainage course which meanders through the adjoining westerly section whereupon it flows into the headwaters of the Olds Creek. The Olds Creek, flowing in a northerly direction, then joins the Little Red Deer River which in turn flows

into the Red Deer River. The approximate distance from the treatment facilities to the Little Red Deer River is 14 miles.

6.3.4 Works Operating Problems

The present oxidation ditch system is not, and has not, given consistently good treatment since it commenced operation.

The effluent is frequently high in suspended solids and BOD₅. The sludge blanket level in the clarifier is often within a few inches of the surface and therefore, the solids carry over at times is quite high. On the other hand, the plant has performed extremely well on occasion and on-site bench scale treatability tests have shown good performance.

The reasons for the inconsistent performance of the plant are presently undetermined.

Possible contributory factors are:

ditch erosion resulting in low velocity areas where solids can settle and turn septic; insufficient aeration during high

loading periods; insufficient oxygen dispersion; or, septic conditions in the clarifier causing floating sludge. The basin is frequently grey-black in colour which is indicative of upset due to lack of oxygen, however, the aerators do have sufficient oxygen supply capabilities.

A major contributing factor to plant upset is the very high flows the plant is subjected to during periods of storm, although no cross connections to the storm sewer have yet been found. These flow peaks cause a surge in the clarifier and a significant carry-over of solids into the chlorine contact chamber and into the discharge drainage course. This results in septic conditions developing in the contact chamber, and in the drainage course, with the resultant odour and nuisance problems. Winter ice blockages and resultant spring land flooding in the drainage course and surrounding area is also a continuing source of complaints from farmers.

6.3.5 Debenture Information

The unmatured debentures on the Olds sewage treatment system were issued for construction of the sewage treatment plant in 1966 and modifications to same plant in 1971. One 1966 debenture was issued for \$30,000, at 5 3/4% interest over a 25 year term for an annual payment of \$2,291.35 and the other debenture was issued later in 1966 for a loan of \$45,387.75 at 5 3/8% interest over 25 years with an annual payment of \$3,411.30. The debentures issued for 1971 upgrading requires annual payments of approximately \$5,710. Therefore, the total annual debenture payments for sewage treatment for the Town of Olds are \$11,412.65.

6.3.6 Service Charge By-Laws

The service charge by-law for the Town of Olds provides for a sewer charge rate of \$2.00 per month for residential connections and approximately \$940 per month for Olds Agricultural College. The remainder of

the sewer service charge rates are shown
below. The revenue generated in 1973 from
sewer service charges was \$41,782.97

SEWER SERVICE CHARGES

<u>Classification</u>	<u>Description</u>	<u>Proposed Rate</u>
1. A.	Domestic Service	2.00 per month
B.	Commercial Service	2.50 per month
2. A.	Public Facilities	4.50 per month
B.	Garages	4.50 per month
C.	Coffee Shops	6.50 per month
D.	Restaurants	7.50 per month
3. A.	Laundries, Cleaners	8.00 per month
B.	Slaughterhouses	10.00 per month
C.	Dairy	35.00 per month
4. A.	Apartments	2.00 per unit per month
B.	Schools	2.00 per classroom per month
C.	Hospitals	1.50 per bed per month
D.	Sherwood Home	4.50 per month
E.	Nursing Home	1.00 per bed per month
F.	Senior Citizens' Home	1.00 per bed per month
5. A.	Trailer Park	1.00 per stall per month
B.	Hotel	35.00 per month
C.	Motel	2.00 per unit per month

DESCRIPTION OF SOME SERVICE CLASSIFICATIONS

1. A. Domestic Service
 - Residential Connection
- B. Commercial Service
 - Stores, Offices, Banks, Lumber Yards,

Churches, Assembly Halls, Lodges,
Firehall, Libraries, Town Garage.

2. A. Public Facilities

- Bowling Alleys, Theatres, Restroom,
Railway Station, Swimming Pool, Arena,
Artificial Ice Plant

6.4 Sewage Treatment Requirements for Future Development

6.4.1 Department of the Environment Standards

The Department of Environment Standards as applied to the Town of Olds require secondary treatment followed by seven months storage of the sewage from the Town.

6.4.2 Alternatives for Sewage Treatment and Disposal

Based on the Department of Environment Standards, the alternative available to the Town of Olds for sewage treatment and disposal are: secondary treatment followed by seven months storage before discharge to the water course; secondary treatment plus a 14 mile outfall line to the Little Red Deer River (this alternative will not be considered here as it is not economical at this time); irrigation preceded by either seven months storage and secondary treatment or an anaerobic-aerobic pond system consisting of 4 anaerobic ponds each of 2-4 days retention

and an aerobic pond of about 2 months retention plus 8 - 9 months storage; or a one year storage system (preceded by an anaerobic - aerobic pond system).

For the purposes of estimating sizes of alternate treatment facilities for the Town of Olds, a water consumption rate of 75 gpd will be used over the full design period for domestic flow, and flows of 250,000 gallons/day and 400,000 gallons/day will be used as the industrial contribution to sewage flows for the periods up to and including 1986, and after 1986 respectively. The estimated daily water consumption figures are given below.

Year	Population	Gcd	Domestic Sewage MGD	Industrial Sewage MGD	Total Sewage MGD
1975	3976	75	.298	.250	.548
1981	5129	75	.385	.250	.635
1986	6322	75	.474	.250	.724
1991	7793	75	.584	.400	.984
1996	9605	75	.720	.400	1.120
2001	11838	75	.888	.400	1.288

Two considerations that must be made regardless of alternatives for sewage treatment and disposal to Olds Creek for the Town of Olds, are the future replacement or twinning of the existing 15 inch diameter outfall line from the Town about 1½ miles to the sewage treatment plant, due to deficiency in capacity, and the construction of a 1½ mile pipeline to a lagoon site northwest of the present treatment plant site.

- i) The alternative of secondary treatment followed by seven months storage in lagoons would require the following lagoon volumes, land areas, and staged construction.

Year	Daily Flow MGD	7 Month Lagoon Capacity MGAL	Staged Construction	
			MGAL	Acres
1975	0.548	115	133	80
1981	0.635	133	20	13
1986	0.724	152	55	32
1991	0.984	207	30	19
1996	1.120	235	35	21
2001	1.288	270		

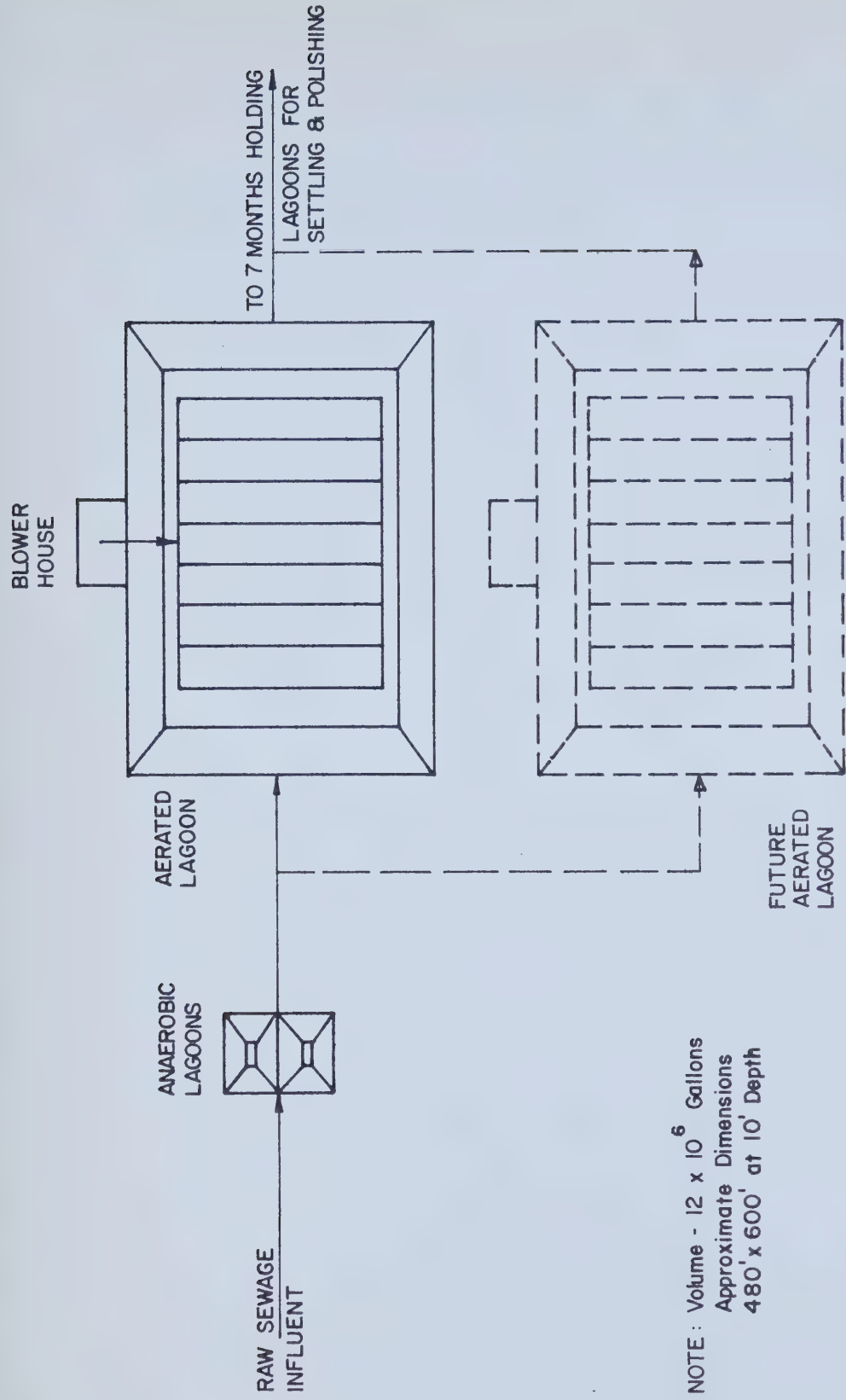
The overall organic load to the treatment plant is calculated assuming 0.17 pounds BOD₅/day per capita; the per capita flow is 75 gcd; and the industrial waste pretreated to the strength of raw sewage.

Year	Daily Flow MGD	Population Equivalent	BOD ₅ Load lbs/day	O ₂ Requirement	
				lbs/day	lbs/hour
1975	.548	7307	1242	1863	78
1981	.635	8467	1439	2159	90
1986	.724	9653	1641	2462	103
1991	.984	13120	2230	3346	139
1996	1.120	14933	2539	3808	159
2001	1.288	17173	2919	4379	182

The existing secondary treatment facility is estimated to have a capacity of about 475,000 Igpd which will not be adequate for the capacity required for operation in the same extended aeration mode if the proposed meat processing facility comes on stream. This plant could be modified by

increasing oxygen supply and mixing, thereby requiring concrete or equivalent lining of the complete ditch. Clarification facilities would require expansion. Also sludge disposal alternatives such as digestion must be looked at. Basically the plant aeration and clarification capabilities would have to be doubled for immediate flow and almost tripled for flows 10 years from now (assuming industrial tie-in).

The alternatives for new secondary treatment facilities are aerated lagoons and activated sludge. Aerated lagoons would require a total design life volume of about 24 million gallons (see Plate 6.4) with an aeration horsepower for oxygen supply of about 100 hp, but 2 - 4 times this requirement would be necessary (depending on method and equipment used) for oxygen dispersion and solids suspension. The major



TOWN OF OLDS

SCHEMATIC FLOW DIAGRAM

OF

AERATED LAGOON ALTERNATIVE

problems with this type of system are:

- a) possible septic conditions
occurring during spring turnover,
- b) solids deposition in the lagoon
reducing effective retention for
treatment necessitating cleaning
at some time,
- c) solids carry-over to holding lagoon
potentially causing septic conditions
at times of the year and reduction
of holding capacity.

The first two problems can generally be alleviated by supplying enough horsepower of aeration to keep solids in suspension, but the third potential problem is an ongoing type of problem which may require facilities for solids removal and handling, (i.e. dredging the lagoon and disposing of the solids). Installation of anaerobic lagoons before the aerated lagoon cell would reduce the grit and organic load to the aerated lagoon.

The activated sludge system, a modification of which is presently employed (extended aeration - oxidation ditch), would require an aeration basin sizing of about 250,000 gallons. This could be supplied by modification of the existing oxidation ditch or more probably, by construction of a new concrete basin. Settling of sludge is a critical parameter for proper operation of an activated sludge plant and therefore the present clarification facilities would need to be increased by 50% initially with total design clarification facilities being more than triple the existing facilities.

The settled sludge is returned to the aeration basin or wasted as required. The waste sludge can either be sent to landfill in its present state or can be digested to reduce the quantity and improve the quality of the sludge rendering it less obnoxious. It is

estimated that at design for 20 plus years in the future, the amount of sludge to be wasted will amount to about 2000 pounds per day.

This type of plant can often be built by staging and this should be a consideration in Olds' case.

An approximate flow sheet showing estimated equipment sizes and staged installation (dotted lines) is illustrated in Plate 6.5.

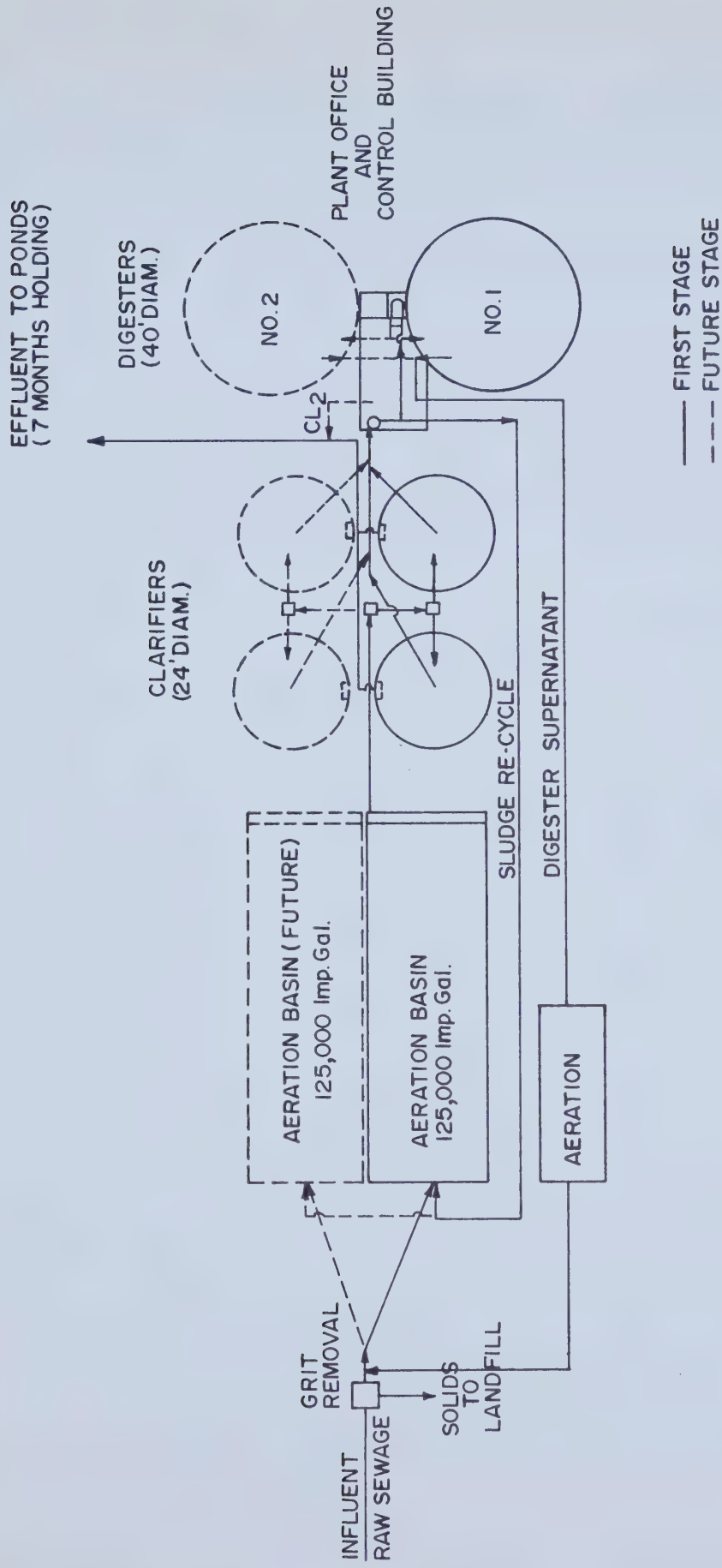
Initially one half of the proposed system - one 125,000 gallon aeration basin, two 24 foot diameter clarifiers or one 34 foot diameter clarifier (10 foot SWD) and one anaerobic digester (40 foot diameter) and all related equipment - could be installed, with the second half of the facility installed around 1986.

Due to the potentially high nitrogenous waste from the proposed meat packing

plant, it is felt that difficulty in settling the biological solids may occur and therefore consideration should be given to a system such as the Kraus process, where digestion supernatant is aerated before return to the aeration basin.

A further alternative for secondary treatment is an activated sludge package plant incorporating aeration, settling, sludge return, sludge digestion, and effluent chlorination. A plant of this type would incorporate the same steps as the conventional plant illustrated in Plate 6.5 with the exception that the digestion would be aerobic rather than anaerobic. Suppliers of this type of package plant are typically Degremont, Smith & Loveless, and Chicago Pump.

- ii) Irrigation preceded by secondary treatment and seven months storage will not be considered further at this time due to the irrigation



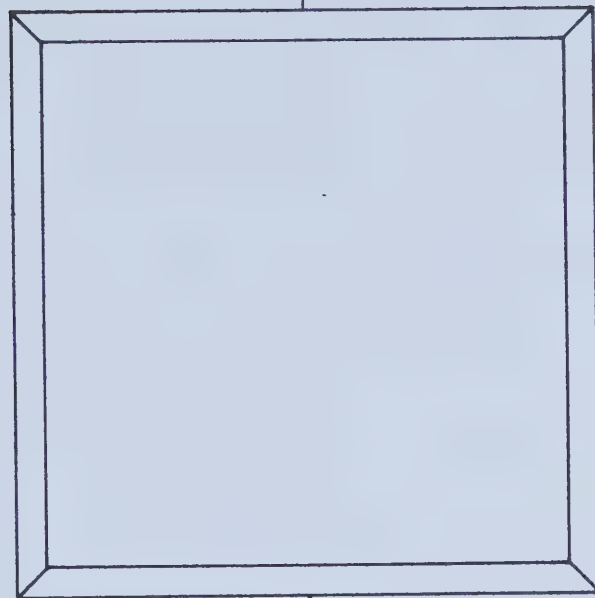
TOWN OF OLDS
 SCHEMATIC FLOW DIAGRAM
 OF
 ACTIVATED SLUDGE ALTERNATIVE

iii) The alternative of twelve months holding in lagoons (see Plate 6.6) would require a total of 560 million gallons or 296 acres by the year 2000 and should be staged to allow for fluctuations in forecasts.

Year	Daily Flow MGD	Anaerobic Aerobic Treatment Pond MGAL	Holding Lagoon MGAL	Total MGAL	Staged Construction MGAL	Construction Acres
1975	.548	37	200	237	275	142
1981	.635	43	232	275	38	26
1986	.724	49	264	313	113	60
1991	.984	67	359	426	57	29
1996	1.120	76	409	483	75	39
2001	1.288	88	470	558		

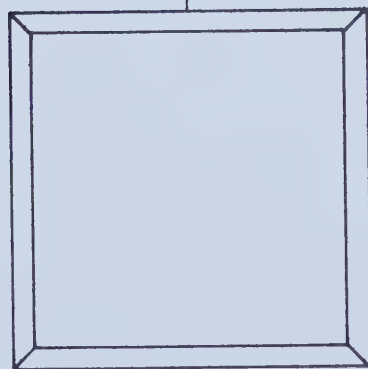
iv) A modification of the secondary treatment plus seven months storage in lagoons alternative which would require approval by the Department of the Environment would be secondary treatment including chlorination with continuous discharge to Olds Creek for all but the four winter months.

ONE YEAR HOLDING LAGOONS

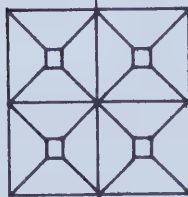


EFFLUENT TO
DRAINAGE COURSE

AEROBIC LAGOON



ANAEROBIC
LAGOONS



RAW SEWAGE
INFLUENT

TOWN OF OLDS

SCHEMATIC FLOW DIAGRAM
OF
ONE YEAR STORAGE ALTERNATIVE

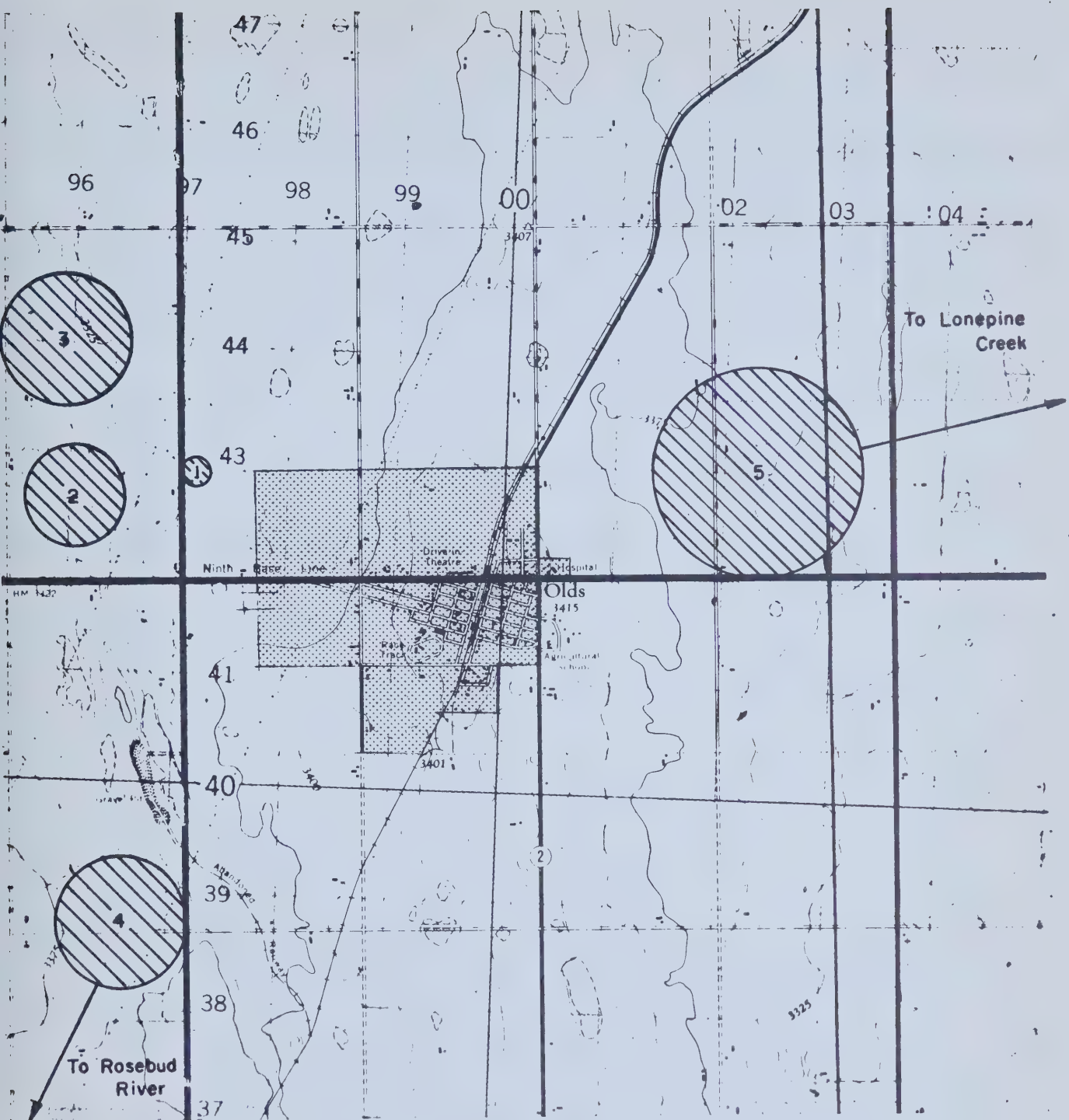
Holding lagoons would be required for storage over the winter to prevent ice blockages in the drainage course and the resultant land flooding during spring thaw.

The land areas required for holding lagoons are summarized as follows:

Year	Daily Flow MGD	4 Month Lagoon Capacity MGAL	Staged Construction	
			MGAL	Acres
1975	0.548	66	76	46
1981	0.635	76	11	8
1986	0.724	87	31	18
1991	0.984	118	16	11
1996	1.120	134	18	12
2001	1.288	152		

The most economical and reliable treatment plant is considered to be a package treatment plant including aeration, settling, sludge return, sludge digestion, and chlorination.

v) A note should be made at this time regarding disposal to drainage courses. There are two drainage courses additional to Olds Creek in the vicinity of Olds; Rosebud River to the southwest, and Lone Pine Creek to the northeast. Neither of these drainage courses have been considered to date for disposal due to their distances from Olds and the probable requirement of pumping sewage to reach them. However, when considering abandoning the present plant and constructing a new line to the treatment site, alternative treatment sites are certainly worth investigation. Plate 6.7 illustrates potential areas for lagoon construction prior to discharge to the alternative drainage courses. The Rosebud River is approximately 5 to 6 miles away from Olds and is not too much better defined than is Olds Creek. The river meanders southeast past Didsbury (it receives



- ① Existing Treatment Site
- Possible Lagoon Sites for Discharge To:
- ② & ③ Olds Creek
- ④ Rosebud River
- ⑤ Lonepine Creek

TOWN OF OLDS

POSSIBLE SITES FOR LAGOON CONSTRUCTION
SCALE: 1" = 50,000"



treated sewage from Didsbury) and eventually ties in with the Red Deer River. The Lone Pine Creek drainage course is about 5 miles northeast of Olds and although the creek is intermittent, it flows in a very well defined drainage course. It too ties in with the Red Deer River.

In the event that land suitable for lagoon construction is unobtainable northwest of Olds for holding before discharge into Olds Creek, consideration should be given to relocating the treatment site and disposing of treated sewage into either of these other two drainage courses.

6.4.3 Costs of Alternative Sewage Treatment and Disposal Schemes

The cost of a new 24 inch diameter $1\frac{1}{2}$ mile pipeline to the existing sewage treatment site and construction of a new $1\frac{1}{2}$ mile line to the lagoon site would each cost in the

order of \$175,000. Twinning the existing line with a new 15 inch diameter line is estimated to cost about \$150,000.

i) A seven months holding lagoon system is estimated to cost about \$668,030 by the year 2000.

Year	Staged Lagoon Construction Costs	Land Cost	Other Costs	Engineering & Contingencies	Total
----- 1975 Dollars -----					
1975	217,100	40,000	25,700	42,400	325,100
1981	32,640	6,500	4,000	6,450	49,590
1986	89,770	16,000	10,600	17,450	133,820
1991	48,970	9,500	5,850	9,650	73,970
1996	57,130	10,500	6,760	11,160	<u>85,550</u>
					668,030

Upgrading the existin facilities to have 10 years design capacity is estimated to cost in the order of \$600,000. This would include sludge digestion. In ten years time another doubling of the plant would be necessary and this would cost

about \$700,000.

An aerated lagoon system is estimated to cost about \$200,000 including blowers, air distribution, blower house, and aeration lagoons. This system could be staged by building one lagoon of about 12 million gallons capacity initially, and installing about one half of the estimated aeration equipment. The second half of the system could be built around 1986. Each stage would cost about \$100,000.

The completely new conventional activated sludge treatment system is estimated to cost in the order of \$1.5 million which could be broken into 2 stages of \$750,000 each with the second stage constructed in about 1986.

Of these three alternatives, the most economical is the aerated lagoon system, which is estimated to have a total cost of \$1,218,030 which would include a

new pipeline to the existing site, a pipeline to a lagoon site about 1½ miles to the west, 7 months lagoon storage, and an aerated lagoon system.

Year	Pipeline to Exist- ing Site	Pipeline to Lagoon Site	7 Month Lagoon	Aerated Lagoon	Operating Cost	Total Capital Cost
----- 1975 Dollars -----						
1975	175,000	175,000	325,100	100,000	7,200	775,100
1981			49,590		7,200	49,590
1986			133,820	100,000	14,400	233,820
1991			73,970		14,400	73,970
1996			85,550		44,400	<u>85,550</u>
						1,218,030

Amortizing these amounts over 25 years at 10% interest rate would amount to an initial per capita annual payment of \$21.48 plus the existing per capita payment of \$2.87 totalling \$24.35. Therefore, the Town of Olds would be eligible for \$10.59/capita/year assistance initially

Year	Population	Total Cost	Debenture Payment	Annual Payment	\$/Capita	Existing Debenture \$/Capita	Total \$/Capita
1975	3976	775,100	85,392	85,392	21.48	11,413	24.35
1981	5129	87,850	9,678	95,070	18.54	2.23	20.77
1986	6322	667,110	73,495	168,565	26.66	1.81	28.47
1991	7793	339,890	37,445	206,010	26.44	1.46	27.90
1996	9605	633,095	69,747	275,757	28.71		28.71

ii) The costs of an irrigation system sufficient to the year 2000 including treating and holding ponds and irrigation land, but excluding irrigation equipment and operating costs, is estimated to be \$1,812,400, plus a pipeline to the existing site and then to the lagoon site costing \$350,000 for a total estimate of \$2,162,400.

Year	Pipeline To Site	Pipeline To Lagoon	Lagoon Const.	Land Cost	Other Costs	Engineering & Contingencies	Total Cost	Irrigation Land Cost
----- 1975 Dollars -----								
1975	175,000	175,000	319,920	45,000	39,490	60,210	461,620	425,000
1981			44,050	9,000	5,300	8,750	67,120	60,000
1986			130,580	20,000	15,060	24,840	190,480	175,000
1991			68,550	12,500	8,100	13,370	102,520	90,000
1996			89,870	14,500	9,900	16,390	<u>125,660</u>	<u>115,000</u>
							947,400	865,000

iii) The alternative of twelve months storage in lagoons preceded by an anaerobic - aerobic pond system is estimated to cost \$1,688,140 over the next 25 years.

Year	Pipeline to Existing Site	Pipeline to Lagoons	Lagoon Construction Costs	Land Costs	Other Costs	Engineering & Contingencies	Total Cost
----- 1975 Dollars -----							
1975	175,000	175,000	448,800	71,000	52,000	85,770	1,006,570
1981			62,020	13,000	7,500	12,370	94,890
1986			184,400	30,000	21,400	35,370	271,170
1991			93,030	14,500	10,750	17,740	136,020
1996			122,400	19,500	14,190	23,400	179,490
							<u>1,688,140</u>

Debenturing these amounts at 10% interest over 25 year terms results in an initial annual payment of \$30.76/capita (including existing debenture debt) which would indicate Olds' eligibility for Provincial Assistance.

Year	Population	Total Cost	Debenture Payment	Annual Payment	\$/ Capita	Existing \$	Debenture \$/Capita	Total \$/Capita
1975	3976	1,006,570	110,892	110,892	27.89	11,413	2.87	30.76
1981	5129	168,100	18,520	129,412	25.23		2.23	27.46
1986	6322	773,675	85,235	214,647	33.95		1.81	35.76
1991	7793	625,010	68,857	283,504	36.38		1.46	37.84
1996	9605	1,328,280	146,335	429,839	44.75		-	44.75

iv) The cost of a package activated sludge treatment plant installed at the existing site in 1975 is estimated to approximate \$780,000. In addition to this would be a 1½ mile pipeline to the existing site and another 1½ mile pipeline to the lagoon site each costing \$175,000. The four month holding lagoons are estimated to cost \$382,120 to the year 2000 (see below) for a total system cost of \$1,512,120.

Year	Staged Lagoon Construction Costs	Land Cost	Other Costs	Engineering & Contingencies	Total
----- 1975 Dollars -----					
1975	124,060	23,000	14,700	24,200	185,960
1981	18,650	4,000	2,300	3,700	28,650
1986	51,300	9,000	6,000	10,000	76,300
1991	28,000	5,500	3,350	5,500	42,350
1996	32,600	6,000	3,860	6,400	<u>48,860</u>
					382,120

The initial system cost including pipelines, lagoons, and a package plant would be \$1,315,960. Debenturing these costs at a 10% rate of interest for 25 year terms would result in an initial annual debenture payment of \$39.33 which would qualify Olds for Provincial Assistance initially amounting to \$25.57/capita or \$101,666.

Year	Population	Total Cost \$	Debenture Payment \$	Annual Payment \$	\$/ Capita	Existing \$	Debenture \$/Capita	Total \$/Capita
1975	3976	1,315,960	144,977	144,977	36.46	11,413	2.87	39.33
1981	5129	50,750	5,592	150,568	29.36		2.23	31.59
1986	6322	217,690	23,983	174,551	27.61		1.81	29.42
1991	7793	194,600	21,438	195,989	25.15		1.46	26.61
1996	9605	361,600	39,835	235,824	24.55			24.55

6.5 Recommendation

Our best judgment leads us to recommend that an activated sludge plant (custom or package) with four months storage in lagoons during winter operation, would be most acceptable in terms of economics and flexibility. This recommendation is based on the assumption that Olds' sewage is indeed treatable by conventional biological processes and therefore that upsets in the existing plant are due to hydraulics, oxygen transfer, surge loadings and other such problems and not inhibition of biological action. Before proceeding with construction of a conventional activated sludge plant however, it is recommended that some investigation into the biological treatability of the sewage be carried out. In addition, the process sensitivity to surge flows is even greater than in the present system and therefore, control of extraneous system flows is an absolute necessity.

The treatment of industrial wastewaters by the Town of Olds effectively doubles the size of the required treatment plant (assuming pretreatment to domestic sewage equivalent) and industry must

be required to provide financial assistance through a service charge or equivalent means plus assuming its fair share of annual operating and maintenance costs. It should be noted that assistance from the Federal Government would be available to industry through the Department of Regional Economic Expansion only if industry constructs its own sewage treatment works. In other words, the Town would not be able to obtain money indirectly from DREE through industry.

The initial cost of the above system is estimated to approximate \$1,316,000. This cost would include: a new 1½ mile outfall line to the present plant; an effluent line approximately 1½ miles northwest to a lagoon storage site before discharge to Olds Creek (which eventually flows into the Little Red Deer River); and storage lagoons with capacity for approximately four months of sewage flows. Based on a 10% rate of interest, a 25 year term, a population of 3976, and existing debenture payments of \$2.87/capita, sewage treatment and disposal for Olds would initially cost \$39.33/

capita of which Provincial Assistance would cover \$25.57/capita or \$101,666. Olds would therefore need to generate sufficient revenue from sewer service charges to cover \$54,710 in debenture payments as well as operating and maintenance costs estimated to approximate an additional \$20,000/year.

It is probable that treatment at the existing site with disposal approximately two miles along Olds Creek will require a lift station to enable the treated sewage to reach the drainage course. The cost of this station would approximate \$75,000 and would increase the initial Provincial Assistance by about \$8,300.

In the event that major industry does not locate in Olds, the existing sewage treatment plant will have capacity to handle estimated sewage flows for another 10 to 12 years. To accomplish this however, it would be necessary to line the complete oxidation ditch with concrete (or equivalent) to prevent ditch erosion and allow operation of the third brush aerator. Also, the addition of an aerobic digester is recommended to

decrease the quantity of sludge to be disposed of as well as to render this sludge less obnoxious. The initial cost of the above modifications plus a lift station and a new outfall line to a storage lagoon site (as above - recommended to have 4 months capacity) is estimated to approximate \$450,000. Excluding any C.M.H.C. grants, this capital expenditure would result in total initial debenture payments of approximately \$15.35/capita which would initially qualify Olds for Provincial Assistance approximating \$1.60/capita or \$6,360. Upgrading the effluent line to the treatment plant site at this time would increase the initial Provincial Assistance by approximately \$4.85/capita or \$19,280.

7. VILLAGE OF BOWDEN

7.1 Growth Trends

Present population (1971) and selected levels of population on which to base engineering plans.

Census Year	1951	1956	1961	1966	1971
Population	277	296	437	610	560

The average quinquennial population projection method seems most reasonable for forecasting the population growth potential of Bowden. The building of a water supply line to Bowden will not alter the growth pattern other than not to limit it from a water supply aspect. There will doubtfully be any industrial growth in Bowden and the population growth rate will not be unprecedented.

Year	1971	1976	1981	1986	1991	1996	2001
Population	560	591	652	733	817	891	966

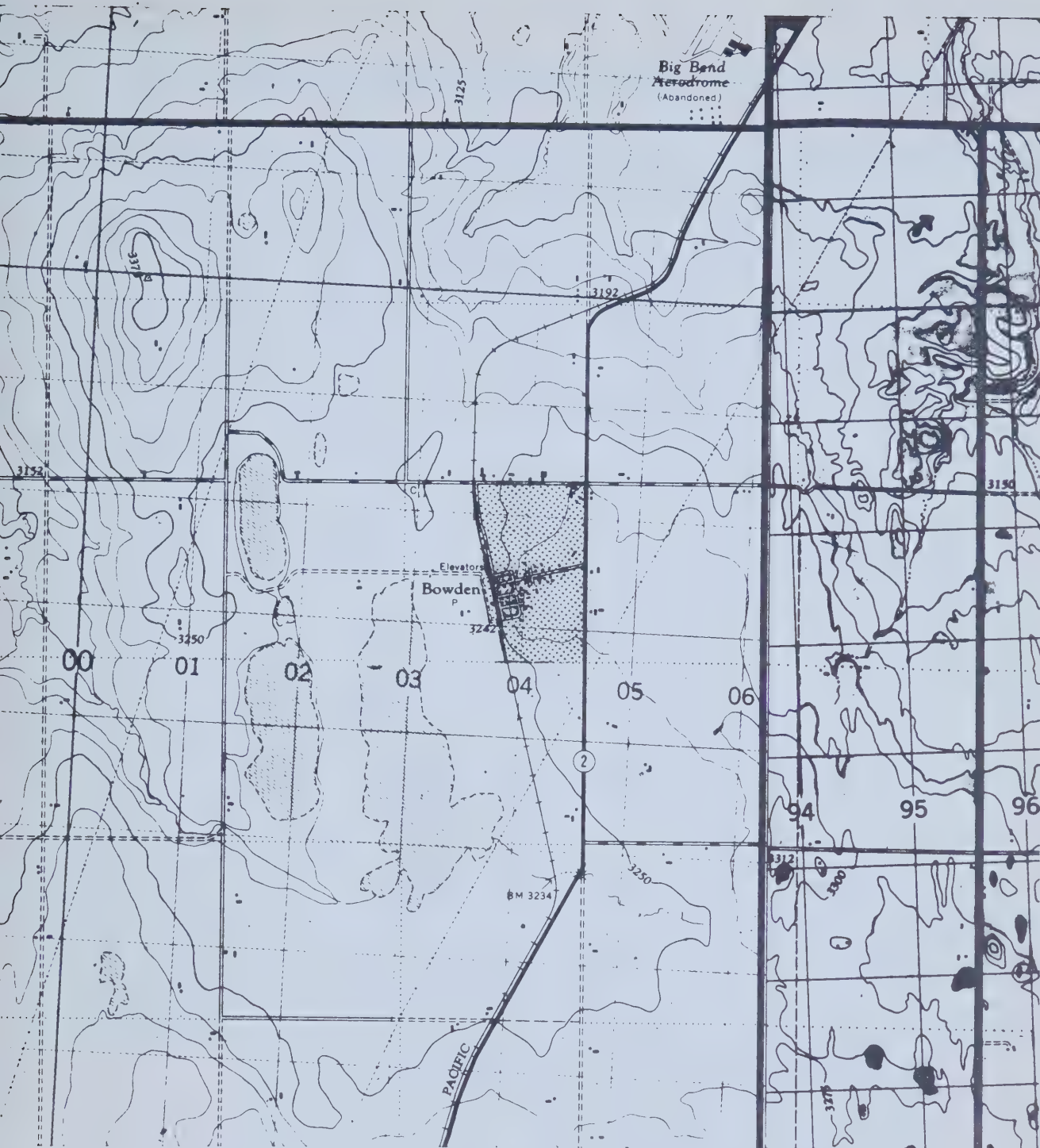
7.2 Photography and Contours

High level air photographs of Bowden and surrounding area (Plate 7.1) were supplied to Underwood McLellan & Associates Limited by the Department of Highways from photos taken by the Alberta Department of Lands and Forests, Aerial Surveys Section. Contour maps of the area surrounding Bowden (Plate 7.2) were reproduced from Geological Survey of Canada, Department of Energy, Mines and Resources maps supplied through the Alberta Department of Lands and Forests.



VILLAGE OF BOWDEN

AIR PHOTOGRAPH
SCALE: 1" = 2640'



VILLAGE OF BOWDEN

CONTOUR MAP
SCALE: 1" = 50,000"



7.3 Sanitary Sewerage System

7.3.1 General Description

The Village of Bowden is serviced by conventional means, that is, an underground system of collection mains employing gravity flow to an outfall line. The outfall line conveys all sewage to the sewage lagoon site as shown in Plate 7.3. All collection mains are 8 inches in diameter and the outfall is a 12 inch diameter line.

7.3.2 Existing Sewage Works

- i) Influent Sewer. This is a 10 inch diameter line up to the lagoons. This line is at an average grade of 0.29% and has an estimated capacity of 1.0 cfs (375 gpm).
- ii) Sewage Lagoons. The existing sewage treatment facilities consist of 2 lagoons in series. The first lagoon has a depth of about 5 feet and acts as an aerobic lagoon of capacity 1.8 million gallons.

The second lagoon has a depth of about 4 feet and a holding capacity of approximately 9.5 million gallons. Therefore, the total capacity of the system is 11.3 million gallons, which at a 1973 population of 565 and a water usage of 72 gpd is 278 days or approximately 9 months.

7.3.3 Outfall and Receiving Area

The outfall is a 12 inch diameter line which discharges the lagoon contents to an 18 inch culvert which in turn discharges the stream to a north to south drainage ditch of approximately 7.6 square feet in cross sectional area and length of about $\frac{1}{2}$ mile where it empties into the P.F.R.A. drainage ditch.

7.3.4 Works Operating Problems

There have been no reported operating problems with the sewage lagoon system to date.

EXISTING
LAGOONS

OUT FALL

DRAINAGE
DITCH



VILLAGE OF BOWDEN

EXISTING SEWAGE TREATMENT LAGOON SYSTEM

SCALE: 1" = 2640'

7.3.5 Works Operating and Maintenance Costs

The only operating and maintenance costs associated with the lagoon are periodic visual checks on the lagoons and drainage of the holding lagoon when it becomes full. There are no definite cost figures assigned to these functions.

7.3.6 Debenture Information

The outstanding debentures relating to sewage treatment are for an extension to the sewer and sewage disposal system in 1960, and sewage lagoon improvements - lagoon drainage system in 1968. The 1960 debenture was issued for 25 years at 5 3/4% for a sum of \$28,900 which yields annual payments of \$2,207.33. The 1968 debenture was issued for 15 years at 6 7/8% for a sum of \$2,499.75 which yields annual payments of \$274.34. Therefore the debenture payments for the Village of Bowden for sewage treatment will be \$2,481.67 per year up to and including 1983, after which time (until 1985)

they will amount to \$2,207.33 per year.

7.3.7 Service Charge By-laws

The service charge by-law for the Village of Bowden provides for a monthly rate of \$3.00 per dwelling. The remainder of the sewer charge classifications are indicated below.

The total revenue from sewer service charges in 1973 was \$7,957.83.

SEWER SERVICE CHARGES

Apartment Houses	\$3.00 per month for each apartment served
Dwellings	\$3.00 per month
Schools	\$2.00 per month per room
Motels	\$30.00 per month
Creamery	\$15.00 per month
Garages	\$ 6.00 per month
Offices	\$ 3.00 per month
Legion, Mason & I.O.O.F. Halls	\$ 5.00 per month
Cafes	\$10.00 per month
Curling Rink	\$ 6.00 per month

Recreation Hall \$ 6.00 per month

Hair Dressing Parlours \$ 3.00 per month

7.4 Sewage Treatment Requirements for Future Development

7.4.1 Department of the Environment Standards

The Department of Environment Standards for the Village of Bowden stipulate one year storage in lagoons with provisions for expansion of facilities to accommodate a growing population.

7.4.2 Alternatives for Sewage Treatment and Disposal

The alternatives for Bowden for sewage treatment and disposal are limited due to the lack of a suitable disposal means. One year storage in lagoons has been set as the requirement by the Department of the Environment and the only possible alternatives to this seem to be 8-9 months storage followed by irrigation, or secondary treatment plus piping treated effluent to some suitable receiving area. This last alternative does not seem economically attractive due to long distances for piping and will not be considered further in this report.

i) The present Bowden sewage lagoon system has a capacity of about 11.3 million gallons. Based on expanding this capacity to one year storage (see Plate 7.4) with allowance for expanding population, the most attractive means of building lagoons is by staging. Staging allows for fluctuations in growth patterns and minimized excess land usage when designing for future flows. The following lagoon cells will be required at the end of each interval (the lagoon land area requirements are based on an average water depth of 10 feet, 3 feet freeboard, and a waterside slope of 3/1 for the berm walls).

Year	Pop.	Gcd	Anaerobic Aerobic Treatment Ponds M.Gal	Holding Ponds M.Gal	Total M.Gal	New Lagoon Size M.Gals	Size Acres
1975	585	75	2.8	16.0	18.8	10	8
1981	652	75	3.2	17.8	21.0	5	4
1986	733	75	3.6	20.0	23.6		
1991	817	75	3.9	22.4	26.3	5	4
1996	891	75	4.3	24.4	28.7		
2001	966	75	4.7	26.4	31.1		

The total increase in land requirements for sewage treatment by lagoons for the Village of Bowden until the end of the century will be approximately 16 acres.

- ii) The alternative of eight months storage (plus four 2-4 day retention anaerobic ponds and 2 months retention aerobic pond) followed by irrigation would require the following land areas (assuming irrigation water application rate of 12 inches per year).

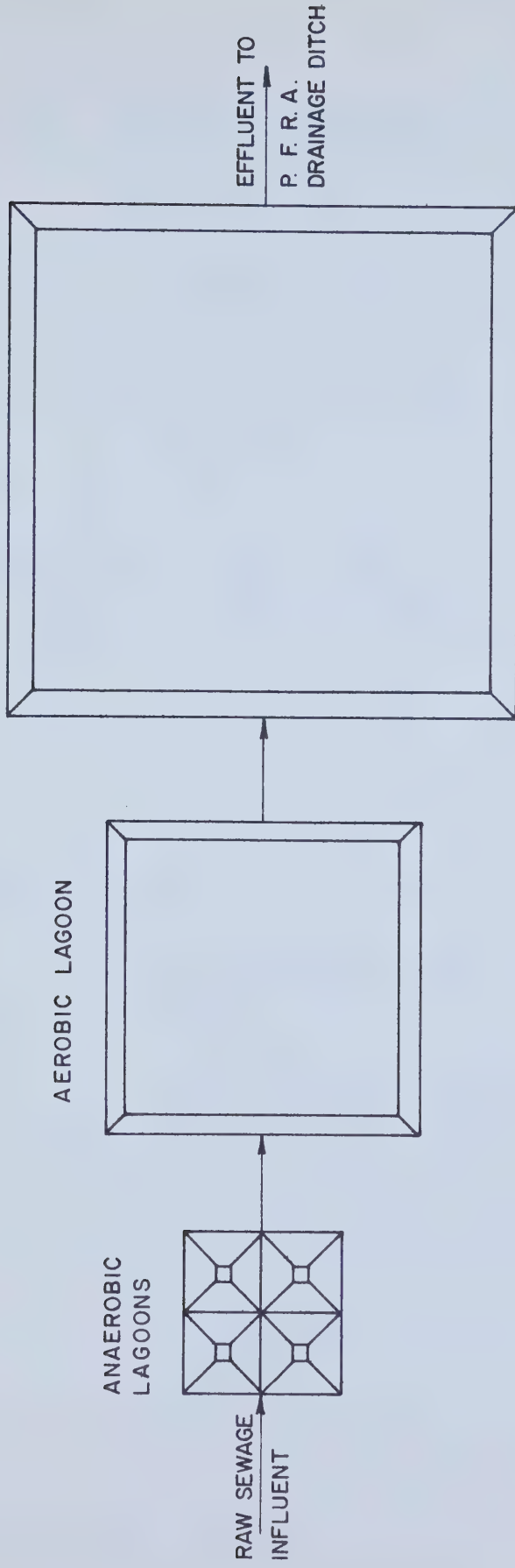
Year	Pop.	Gcd	Total Lagoon Size M. Gal	New Lagoon M.Gal	Size Acre	Total Irrig. Size Acres	Stage Irrig. Land Acquis. Acres
1975	585	75	13.5	5	4	59	65
1981	652	75	15.1			65	9
1986	733	75	16.9	6	5	74	8
1991	817	75	18.9			82	8
1996	891	75	20.6			90	8
2001	966	75	22.3			98	

NOTE: Existing Capacity - 11.3 x 10⁶ Gallons

Required Capacity by 2000 - 31 x 10⁶ Gallons

Additional Land Area 16 Acres

ONE YEAR HOLDING LAGOONS



VILLAGE OF BOWDEN
SCHEMATIC FLOW DIAGRAM
OF
ONE YEAR STORAGE ALTERNATIVE

7.4.3 Costs for Alternative Sewage Treatment and Disposal Schemes

- i) The costs for expanding the lagoon system to supply one year storage at all times based on 1975 land costs of \$400/acre are estimated to total \$49,390.00 in 1975 dollars.

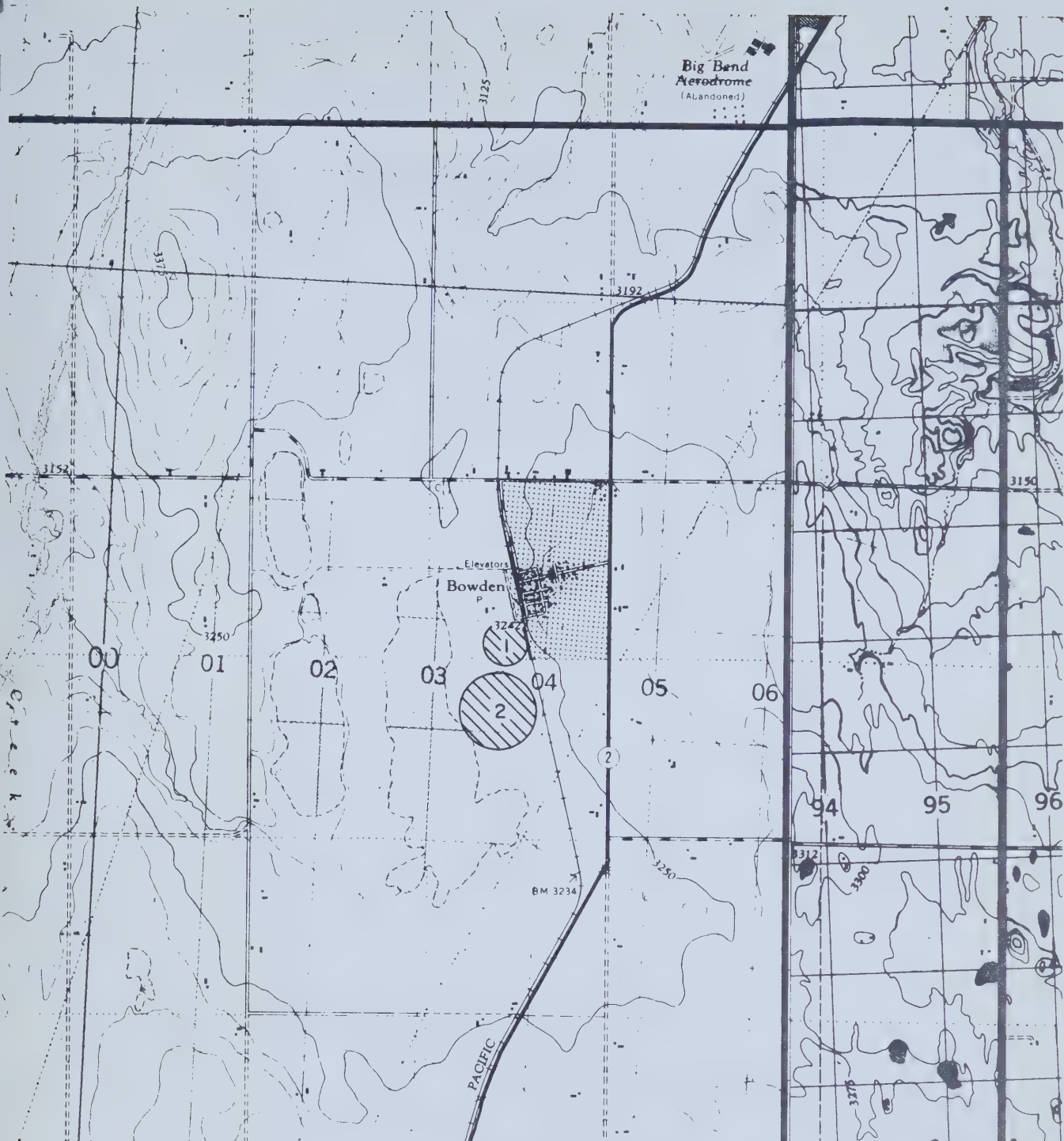
Year	Lagoon Size M. Gals	Lagoon Cost -----	Land Cost 1975 Dollars	Other Cost	Engineering and Contingencies	Total Cost
1975	10	16,321	3,200	1,952	3,221	24,694
1981	5	8,161	1,660	976	1,611	12,348
1986						
1991	5	8,161	1,600	976	1,611	12,348
						<u>49,390</u>

Assuming these lagoon costs are debentured for 25 year periods at 10% rate of interest a schedule of payments can be derived, and it indicates that the total initial annual payment will be \$8.69/capita which would not be high enough to qualify for Provincial Assistance.

Year	Pop.	Total Loan	Debenture Payment	Annual Payment	\$/Capita	Existing Deb. \$/yr.	\$/capita	Total \$/capita
1975	585	\$24,694	\$2,721	\$2,721	\$4.65	\$2,482	\$4.24	\$8.69
1981	652	21,876	2,411	5,132	7.87	2,482	3.81	11.69
1986	733			5,132	7.00	2,207	3.01	10.01
1991	817	56,739	6,251	11,383	13.93	--		13.93
1996	891			11,383	12.78	--		12.78

ii) The costs of an irrigation scheme, excluding irrigation equipment and operation, would amount to \$25,532 for the holding and treatment ponds and \$39,200 for the irrigation land for a total of \$64,732.

Year	Lagoon Size M.Gal	1975 Dollars				Total Lagoon Costs	Irrig. Land Acres	Irrig. Land Costs
		Lagoon Costs	Land Costs	Other Costs	Engineering & Contin- gencies			
1975	5	8161	1606	976	1610	12,347	65	26,000
1981							9	3,600
1986	6	9793	2000	1197	1950	31,185	8	3,200
1991							8	3,200
1996							8	3,200
2001						25,532		39,200



- ① Existing Site
- ② New Site

VILLAGE OF BOWDEN

POSSIBLE SITE FOR LAGOON EXPANSION
SCALE: 1" = 50,000"



7.5 Recommendation

The most economical method for Bowden to treat and dispose of sewage is through a one year storage lagoon system. The total estimated cost of expanding their present system to handle sewage flow to the year 2000 is \$49,390 (in 1975 dollars). It could probably be expanded to the south as illustrated in Plate 7.5. This initial cost can be reduced by staging the lagoon construction. The initial annual cost is estimated to be \$2,721 based on 10% debentures with no C.M.H.C. or Provincial Assistance. The operational and maintenance cost of this system would be in the order of \$2,000 and the existing debenture debt is \$2,482 for a total annual expenditure by the Village of Bowden for sewage treatment of \$7,205. The present sewer service charge rates yielding \$7,958 in revenue in 1973 seem adequate to generate sufficient revenue to cover annual payments for sewage treatment.

8. TOWN OF INNISFAIL

8.1 Growth Trends

Present population (1971) and selected levels of population on which to base engineering plans.

Census Year	1951	1956	1961	1966	1971
Population	1417	1883	2270	2531	2474

The average quinquennial projection method for population forecasting was deemed applicable for Innisfail. The last census showed a reduction

in population, and while this reduction is being reversed the potential for a large growth rate can not be considered too optimistically. On the other hand, a sheep processing plant is under construction in Innisfail, and the work force for this installation, while not large, will serve to bolster the population. For the purposes of this report, a growth rate of 3.1% per year will be used.

Year	1971	1976	1981	1986	1991	1996	2001
Population	2474	2857	3300	3812	4403	5085	5873

8.2 Photography and Contours

High level air photographs of Innisfail and surrounding area (Plate 8.1) were supplied to Underwood McLellan & Associates Limited by the Department of Highways from air photographs taken by the Alberta Department of Lands and Forests, Aerial Surveys Section. Contour maps of the area surrounding Innisfail (Plate 8.2) were reproduced from Geological Survey of Canada, Department of Energy, Mines and Resources maps supplied through the Alberta Department of Lands and Forests.

8.3 Sanitary Sewerage System

8.3.1 General Description

The Town of Innisfail is serviced by an underground system of collection mains employing gravity flow to an outfall line. There are 2 lift stations to pump collected sewage from low lying areas through 4 inch force mains to tie-in with the remainder of the gravity flow system to the outfall. The outfall lines convey all sewage to the sewage disposal site (see Plate 8.3). All collection mains are 8 inches in diameter with two main outfall lines of 12 inch diameter tying into an 18 inch diameter final outfall line.

8.3.2 Existing Sewage Works

- i) Influent Sewer - This is an 18 inch diameter line for the last 2300 feet up to the lagoons. This line is fed by two 12 inch diameter outfall lines, one from the main



TOWN OF INNISFAIL

AIR PHOTOGRAPH
SCALE: 1" = 2640'



TOWN OF INNISFAIL

CONTOUR MAP
SCALE: 1" = 50,000"





TOWN OF INNISFAIL

EXISTING SEWAGE TREATMENT LAGOON SYSTEM
SCALE: 1" = 2640'

town area and the other from the south subdivision area. The 12 inch lines have an approximate estimated capacity of 1.5 cfs (561 gpm) each and the 18 inch outfall line has a capacity estimated to approximate 3.4 cfs (1275 gpm).

ii) Lift Stations - There are two lift stations in the Town of Innisfail, and they lift the collected sewage from low lying areas to an elevation where the sewage can gravity flow with the remainder of the collected sewage to the lagoon site. The lift stations employed at Innisfail pump the sewage from the collection points through 4 inch force mains to the appropriate discharge locations.

iii) Sewage Lagoons - The existing sewage treatment facilities consist of four anaerobic lagoons (cell numbers 1 to 4) and three aerobic lagoons (cell

numbers 5 to 7). The anaerobic lagoons are each about 9 feet deep and 275,000 gallons in capacity. The first aerobic lagoon, cell number 5, is 5 feet deep and has a capacity of about 4.1 million gallons. The second aerobic lagoon, cell number 6, is 6.5 feet deep with a capacity of about 21.4 million gallons. The third and most recent aerobic lagoon, cell number 7, is 10 feet deep and has an approximate capacity of 20.0 million gallons. This cell number 7 was completed in 1968. The total volumetric capacity of the Innisfail lagoon system is approximately 46.6 million gallons or at a 1973 population of 2485 and a per capita water usage of 73 gpd this system has a retention of 257 days or about 8½ months.

8.3.3 Outfall and Receiving Area

The outfall from the lagoon system is into

a well defined drainage area. The creek in this drainage area meanders along until it flows into the Red Deer River approximately 4 miles distance.

8.3.4 Works Operating Problems

There have been no particular operating problems associated with the operation of the Town's sewage disposal system. The lagoons are almost full at the expiration of the seven month holding period.

8.3.5 Works Operating and Maintenance Costs

The annual operating and maintenance cost associated with operation of the sewage treatment lagoon system are approximately \$1,135. Very little maintenance is required for a lagoon system and the only real operation required is when the ponds are discharged to the creek.

8.3.6 Debenture Information

The debentures for the sewage works according to the Town records were issued in 1968

for a 20 year term at $7\frac{1}{2}\%$ interest with equal annual payments of \$653.98 and in 1970 for a 20 year term at $6-7/8\%$ interest with an annual payment of \$949.61. Therefore, the total annual existing debenture payments for the sewage treatment works is \$1,603.59.

8.3.7 Service Charge By-Laws

The present service charge by-laws for the Town of Innisfail were under revision at the time of this report. However, the intention of the proposed new by-law is to charge on a water usage rate as opposed to a flat monthly rate. The revenue from sanitary sewer service charges in 1973 was \$41,414.31.

8.4 Sewage Treatment Requirements for Future Development

8.4.1 Department of the Environment Standards

The Department of the Environment Standards as applied to the Town of Innisfail call for one year storage in lagoons with expansion of facilities to compensate for industrial development and population growth.

8.4.2 Alternatives for Sewage Treatment and Disposal

The alternatives available to the Town of Innisfail for treatment and disposal of sewage are limited by the availability of suitable drainage courses. Therefore, the Department of the Environment has required one year storage in lagoons. The alternative scheme to this which would require approval from the Department of the Environment would be for secondary treatment followed by a pipeline to the Red Deer River for discharge. A third alternative would be irrigation preceded by 8 - 9 months storage and an anaerobic - aerobic pond system.

For treatment facility estimating purposes the industrial contribution to wastewater volume is estimated to amount to 75,000 gallons per day until 1986 (i.e. 50,000 gallons per day for the sheep processing plant and 25,000 gallons per day for other industry), with an increase to 125,000 gallons per day to the end of the century (i.e. 75,000 gallons per day for the sheep processing plant and 50,000 gallons per day for other industry), and the domestic contribution is assumed to remain constant at 75 gcd. It should be noted that while allowance has not been made for location of any significant "wet" industry in Innisfail, it is quite possible that this could occur with an accompanying significant increase in the industrial wastewater load.

i) The existing lagoon system has a storage capacity of approximately 46.6 million gallons. The required capacity for one year storage (see Plate 8.4) by the year 2001 will be 244.8 million gallons or an increase of 198 million gallons (i.e. for a total of about 5 times the present capacity).

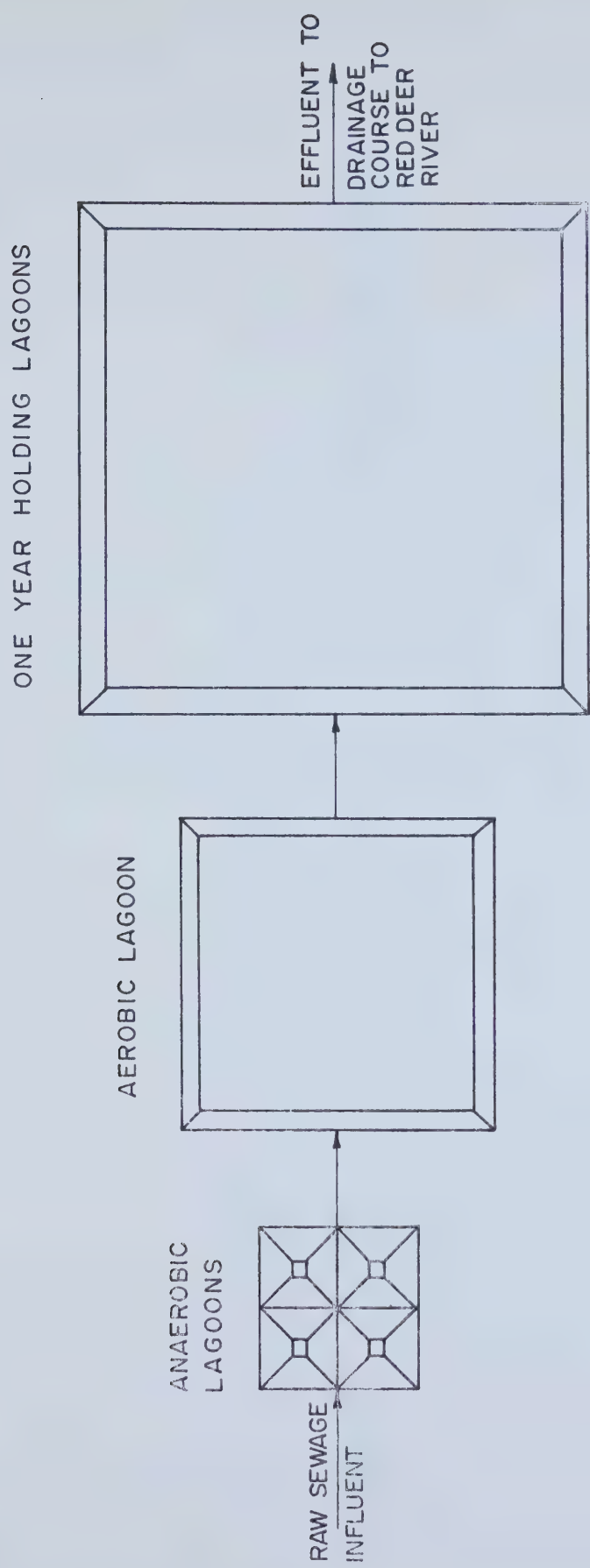
Year	Population	Gcd	One Year Storage Capacity		Anaerobic Aerobic Treatment Ponds	Total M.Gal	Staged Lagoons M.Gal	Lagoons Acres
			Domestic M.Gal	Industrial M.Gal				
1971	2,474	73	65.9	-		65.9		
1976	2,857	75	78.2	27.4	18.6	124.2	93	45
1981	3,300	75	90.3	27.4	21.9	139.6	17	9
1986	3,812	75	104.4	27.4	24.5	156.3	41	20
1991	4,403	75	120.5	45.6	31.4	197.5	22	12
1996	5,085	75	139.2	45.6	34.4	219.2	25	14
2001	5,873	75	160.8	45.6	38.4	244.8		

To reduce initial capital costs, reduce the non-productive use of land area for a length of time, and to allow for any variations in population growth and industrial

development from those forecast,
it will be more suitable to stage the
expansion of the lagoon system rather
than build the complete system at
present.

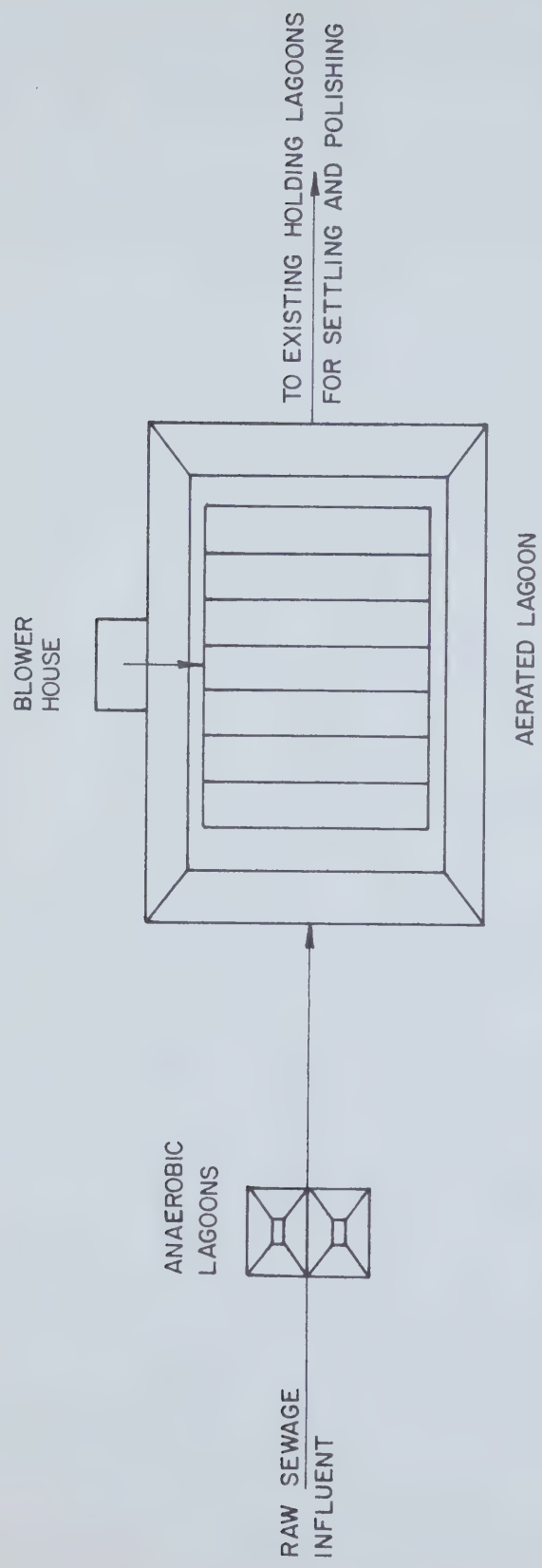
- ii) The alternative to this one year
storage requirement would be secondary
treatment plus an effluent discharge
line to the Red Deer River. With
consideration given to the existing
system of collection and disposal
the most economical option would
seem to be to use the existing system,
with some modifications, as the
secondary treatment system and to
construct an outfall line to the
Red Deer River. The most suitable
secondary treatment scheme for
Innisfail, therefore,
would be an aerated lagoon system
(see Plate 8.5). The first pond of
the existing system could be modified
to about 8 foot average water depth,

NOTE: Existing Capacity - 46.6×10^6 Gallons
 Required Capacity by 2000 - 245×10^6 Gallons
 Additional Land Area - 100 Acres



TOWN OF INNISFAIL
 SCHEMATIC FLOW DIAGRAM
 OF
 ONE YEAR STORAGE ALTERNATIVE

NOTE Volume - 5.0×10^6 Gallons
Approximate Dimensions
330' x 450' at 10' Depth



TOWN OF INNISFAIL
SCHEMATIC FLOW DIAGRAM
OF
AERATED LAGOON ALTERNATIVE

and subsurface aeration equipment could be installed in this pond (alternatively a new aeration pond of about 5 MGAL capacity could be built). The anaerobic ponds could remain in service at the beginning of the system for grit collection and primary solids collection and digestion, and the two remaining aerobic lagoons would remain in service to accomplish solids settling and effluent polishing. The organic load on the system is difficult to estimate due to the unknown influence of industry. Therefore, for the purposes of this study, an organic loading of 0.17 pounds BOD₅/day per population equivalent (based on flow of 75 gcd) an oxygen requirement of 1.5 lbs. O₂/lb. BOD₅ will be assumed (that is, industry will pretreat its wastewater to equivalent domestic strength).

Year	Daily Flow MGD	Retention Time in Aeration Pond (Days)	Population Equivalent	BOD ₅ Lbs/day	O ₂ Required Lbs/day	Lbs/hr.
1971	0.180	-	2,407	409	614	26
1976	0.289	17.3	3,857	656	984	41
1981	0.322	15.5	4,299	731	1097	46
1986	0.361	14	4,815	819	1229	51
1991	0.455	11	6,068	1032	1548	65
1996	0.506	10	6,751	1148	1722	72
2001	0.565	9	7,540	1282	1923	80

Since the overriding criteria in a system of this type is oxygen dispersion and solids circulation rather than oxygen supply, approximately 80 hp of aeration equipment would be required to keep the solids in suspension. Therefore, staging should not be used for aeration equipment.

The second part of this system would be an outfall line to the Red Deer River. This line would be a force main of about 10 inches in diameter. The length of line would be in the order of 4 miles. A pumping station

would be situated at the treatment plant and would be capable of pumping an average of 225 gpm in 1981 up to 400 gpm in the year 2000. This can be accomplished by installation of two 225 gpm pumps (1 on standby) initially and addition of a third 225 gpm pump at a later date.

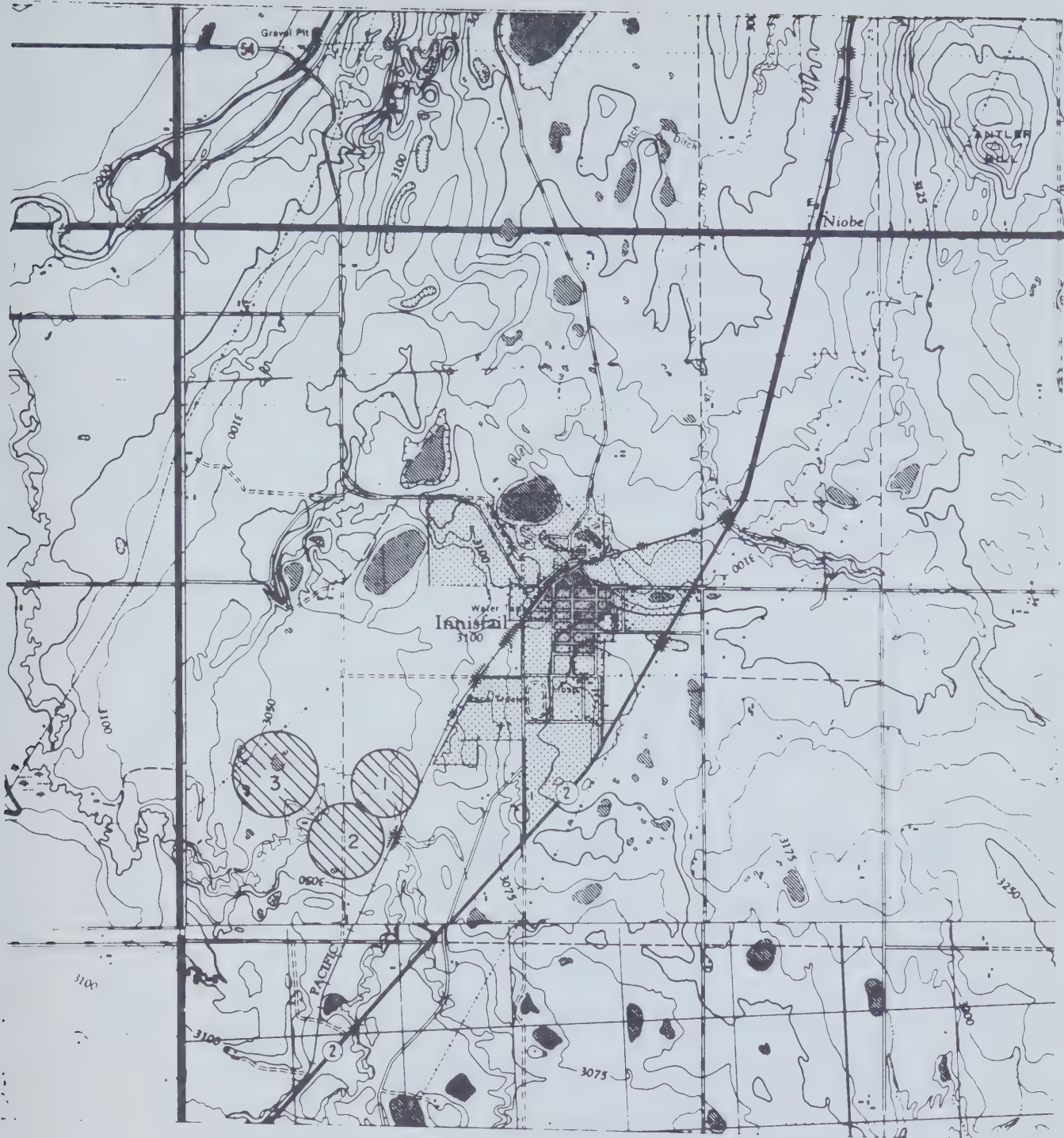
Before proceeding with such a system the character of the industrial wastes, particularly the sheep processing plant wastes, should be evaluated to determine the feasibility of treating them in an aerated lagoon system. For example, meat processing wastes characteristically have high nitrogenous oxygen demands which increase the oxygen supply requirements as well as decreasing the settleability of the treated effluent.

- iii) The land area requirements for irrigation preceded by 8 months

storage (plus 4 - 2 day anaerobics and 2 months of aerobic ponds) would be (based on an application rate of 12 inches per year) about 80 acres for holding ponds and 760 acres for irrigation land. Plate 8.6 illustrates possible sites for lagoon construction.

Year	Daily Flow MGD	Total Lagoon Size MGAL	Land Area Acres	Stages Construction MGAL Acres	Irrigated Land Area Acres	Staged Acquisition Acres	Total Staged Acquisition
1975	.289	87.9	50	52 31	388	432	463
1981	.322	97.9	55	11 7	432	53	60
1986	.361	109.7	61	30 19	485	26	45
1991	.455	138.3	76	14 10	611	68	78
1996	.506	153.8	84	18 12	679	80	92
2001	.565	171.8	93		759		

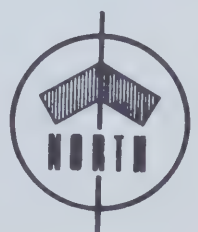
iv) One further alternative which has not yet been discussed is a modified combination of other alternatives. The sewage treatment and disposal system would consist of a conventional activated sludge plant, including



- ① Existing Site
- ② ③ New Sites

TOWN OF INNISFAIL

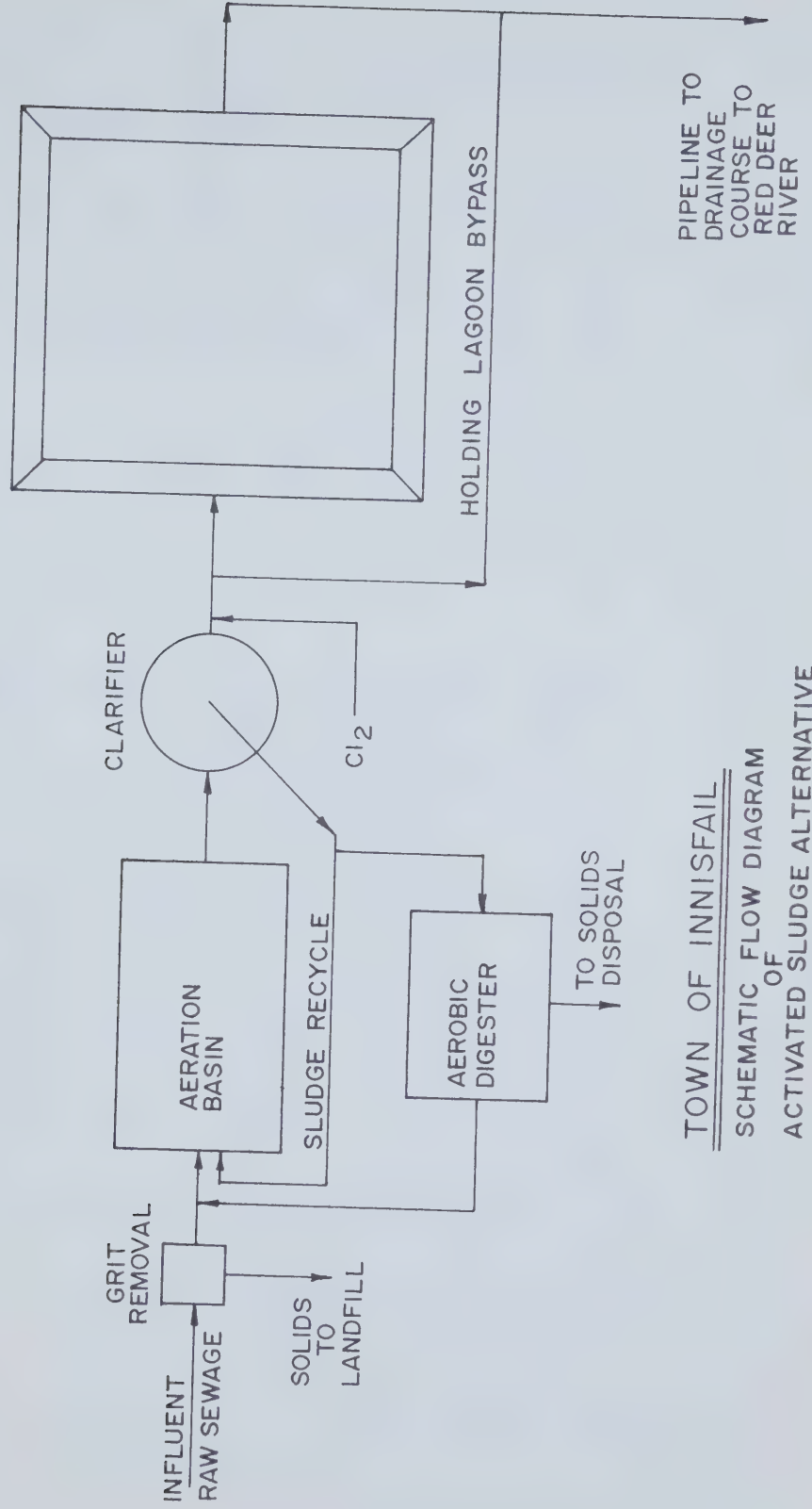
POSSIBLE SITES FOR LAGOON EXPANSION
SCALE: 1" = 50,000"



digestion, followed by four months winter holding, and an effluent pipeline approximately two miles along the drainage course. The secondary treatment operation could be carried out by a package plant, such as Degremont, Smith & Loveless, Greey Mixing, etc., with aerobic digestion of the waste sludge before disposal to landfill. The effluent from the plant, would be chlorinated over the continuous discharge period (approximately 8 months) and would by-pass the holding ponds and flow through the effluent pipeline to the drainage course. During the winter period the effluent would not require chlorination and would flow to the existing lagoon system for storage (illustrated on Plate 8.7). The existing lagoon system is estimated (based on populations and flows forecast in this report) to have 4 months holding capacity until

about 1986 - 1987 at which time an additional holding lagoon of approximately 20 million gallons capacity would be required. The pipeline would be a gravity line running approximately two miles to a point where the drainage course alters its course from a westerly to a northerly direction. An aerial survey of the drainage course to the Red Deer River resulted in selection of this tie-in point immediately downstream of a farm residence approximately 2 miles from the existing lagoon system. The drainage course is reasonably well defined for most of its length, but it meanders through the above mentioned farmyard. It is considered, therefore, more reasonable to have the sewage treatment plant discharge downstream of the farmyard.

4 MONTHS WINTER
HOLDING LAGOONS



TOWN OF INNISFAIL
SCHEMATIC FLOW DIAGRAM
OF
ACTIVATED SLUDGE ALTERNATIVE

8.4.3 Costs for Alternative Sewage Treatment and Disposal Schemes

- i) The costs of expanding the lagoon system to allow for capacity for one year storage for sewage flows to the year 2000 would cost an estimated \$465,422. This cost can be spread out by staging construction as follows:

Year	Lagoon Size MGAL	Lagoon Costs	Land Cost	Other Costs	Engineering & Contingencies	Total Cost
----- 1975 Dollars -----						
1975	92	150,166	21,600	17,180	28,342	217,288
1981	16	26,116	4,400	3,052	5,035	38,603
1986	41	66,922	10,000	7,692	12,692	97,306
1991	22	35,909	5,600	4,151	6,849	52,509
1996	25	40,806	6,400	4,721	7,789	<u>59,716</u>
						465,422

Debenturing these amounts at 10%/yr. interest rate over 25 year terms results in an initial annual payment of \$9.22/capita.

Year	Population	Total Cost	Debenture Payment	Annual Payment	\$/Capita	Existing Annual \$	Debenture \$/Capita	Total \$/ Capita
1975	2,771	217,288	23,938	23,938	8.64	1,604	0.58	9.22
1981	3,300	68,389	7,534	31,472	9.54	1,604	0.49	10.03
1986	3,812	277,624	30,585	62,057	16.28	1,604	0.42	16.70
1991	4,403	241,279	25,581	87,638	19.90	-	-	19.90
1996	5,085	441,916	48,685	136,323	26.81	-	-	26.81

ii) The costs of an aerated lagoon system with an outfall to the Red Deer River are estimated to be \$620,010 plus operational costs of the treatment system to the year 2000 of \$149,760 and pumping costs of \$42,400 to the year 2000 for a total of \$812,250.

Year	Secondary Treatment Costs	Operating Costs	Pump Station Costs	Operating Costs	Pipeline Costs	Engineering & Contingencies	Total Cost
----- 1975 Dollars -----							
1975	65,000	5,760	50,000	1,080	422,400	76,860	614,260
1976-							
1980		28,800		5,400			
1981		5,760		1,080			
1982-							
1985		23,040		4,320			
1986		5,760	5,000	1,800		1,750	5,750
1987-							
1990		23,040		7,200			
1991		5,760		2,160			
1992-							
1995		23,040		8,640			
1996		5,760		2,160			
1997-							
2000		<u>23,040</u>		<u>8,640</u>			
		149,760		42,480			620,010

Assuming that the capital costs are debentured at 10% per year for 25 years the total initial cost of the system becomes \$24.99/capita.

Year	Population	Capital Cost	Debenture Payment	Annual Payment	\$/ Capita	Existing Debentures \$/Capita	Total \$/Capita
1975	2,771	614,260	67,667	67,667	24.41	1,604 0.58	24.99
1981	3,300			67,667	20.51	0.49	21.00
1986	3,812	16,405	1,807	69,474	18.22	0.42	18.64
1991	4,403			69,474	15.78	- -	15.78
1996	5,085			69,474	13.66	- -	13.66

iii) The costs of an irrigation system would amount to \$298,070 for the lagoon storage and \$296,800 for irrigation land for a total of \$594,870 not including irrigation equipment and operating costs.

Year	Lagoon Size MGAL	Lagoon Costs	Land Cost	Other Costs	Engineering & Contingencies	Total Costs	Irrigation Acres	Land Cost
-----1975 Dollars-----								
1975	52	84,877	12,400	9,728	16,050	123,055	423	169,200
1981	11	17,955	2,800	2,075	3,425	26,255	38	15,200
1986	30	48,967	7,600	5,658	9,330	71,555	137	54,800
1991	14	22,850	4,000	2,685	4,430	33,965	67	26,800
1996	18	29,380	4,800	3,420	5,640	<u>43,240</u>	77	<u>30,800</u>
						298,070		296,800

iv) The cost of an activated sludge package plant constructed in 1975 is estimated to approximate \$545,000. A gravity pipeline two miles to the drainage course is estimated to cost \$160,000 resulting in an initial overall capital cost of \$705,000. The additional cost of constructing 20 million gallons of lagoons in 1986 - 1987 would approximate \$50,000. At the population figures forecast earlier in this report, the existing debenture payments in 1975 would amount to \$0.58/capita. Debenturing the \$705,000 at 10% interest for a 25 year term would result in annual payments of \$77,670. Innisfail would, therefore, be eligible for Provincial Assistance initially amounting to \$41,150/year or \$14.85/capita/year.

8.5 Recommendation

The sewage treatment and disposal system recommended for the Town of Innisfail is a conventional activated sludge package plant with a two mile pipeline to the drainage course which flows into the Red Deer River. It is recommended that the above treatment scheme, including chlorination of the final effluent, be employed for approximately eight months of the year with the remaining four months, during the winter period, incorporating holding lagoons to prevent discharge over this period and therefore, ice blockages and the resultant land flooding during the spring thaw. The existing lagoons would be adequate for this service for 10 to 12 years based on flow projections contained in this report.

In the event of new wet industries locating in Innisfail, the activated sludge system would be easily expandable without a large land area requirement by adding a parallel unit.

The initial annual expenditures by the Town are outlined as follows:

Debenture	\$38,130 (+41,150 Provincial Assistance)
Operating	9,000
Maintenance	<u>6,000</u>
Total	\$53,130

The 1973 revenue from sewer charges was \$41,414.

These rates are presently under review, but assuming industry is required to provide financial assistance through a service charge plus assuming responsibility for its fair share of annual operating and maintenance costs, the new rates should provide sufficient revenue to cover the annual payments for sewage treatment and disposal.

It should be noted that assistance from the Federal Government would be available to industry through the Department of Regional Economic Expansion only if industry constructed its own sewage treatment works. In other words, the Town would not be able to obtain money indirectly from DREE through industry.

